



CSBA

Center for Strategic and Budgetary Assessments

RESTORING AMERICAN SEAPOWER

A NEW FLEET ARCHITECTURE FOR THE
UNITED STATES NAVY

BRYAN CLARK PETER HAYNES

BRYAN MCGRATH CRAIG HOOPER

JESSE SLOMAN TIMOTHY A. WALTON

RESTORING AMERICAN SEAPOWER

A NEW FLEET ARCHITECTURE FOR THE UNITED STATES NAVY

BRYAN CLARK
PETER HAYNES
BRYAN MCGRATH
CRAIG HOOPER
JESSE SLOMAN
TIMOTHY A. WALTON

CSBA

Center for Strategic and Budgetary Assessments

2017

ABOUT THE CENTER FOR STRATEGIC AND BUDGETARY ASSESSMENTS (CSBA)

The Center for Strategic and Budgetary Assessments is an independent, nonpartisan policy research institute established to promote innovative thinking and debate about national security strategy and investment options. CSBA's analysis focuses on key questions related to existing and emerging threats to U.S. national security, and its goal is to enable policymakers to make informed decisions on matters of strategy, security policy, and resource allocation.

ABOUT THE AUTHORS

Bryan Clark is a Senior Fellow at the Center for Strategic and Budgetary Assessments. Prior to joining CSBA in 2013, Bryan Clark was Special Assistant to the Chief of Naval Operations and Director of his Commander's Action Group, where he led development of Navy strategy and implemented new initiatives in electromagnetic spectrum operations, undersea warfare, expeditionary operations and personnel and readiness management. Mr. Clark served in the Navy headquarters staff from 2004 to 2011, leading studies in the Assessment Division and participating in the 2006 and 2010 Quadrennial Defense Reviews. He is the recipient of the Department of the Navy Superior Service Medal and the Legion of Merit.

Peter Haynes is a Senior Fellow at the Center for Strategic and Budgetary Assessments specializing in grand strategy, maritime and naval strategy, the development of strategy and operational concepts, naval and air warfare, the future of conflict, special operations, and irregular warfare. Prior to retiring from the U.S. Navy in 2016 as a captain, he served as the Deputy Director, Strategy, Plans, and Policy (J5) at U.S. Special Operations Command. He is the recipient of the Defense Superior Service Medal, the Legion of Merit, the Air Medal with Combat "V," and the Navy/Marine Corps Commendation Medal with Combat "V," as well as the 2009–2010 Naval History and Heritage Command's Samuel Eliot Morison Naval History Scholarship.

Bryan McGrath is the Assistant Director of Hudson Institute's Center for American Seapower and the Managing Director of The FerryBridge Group LLC. An active duty naval officer from 1987 to 2008, he served in cruisers and destroyers, commanding USS BULKELEY (DDG 84) from 2004–2006, during which time the ship earned the Battle "E" Award and the USS ARIZONA Memorial Trophy, signifying its status as the most combat-ready ship in the Fleet.

Craig Hooper is an author and commentator on naval affairs at www.NextNavy.com. After earning a Ph.D. in Immunology and Infectious Diseases at Harvard University, he lectured at the Naval Postgraduate School. In 2011, Dr. Hooper was recruited to serve as a Vice President at Austal USA, builder of the Littoral Combat Ship and Expeditionary Fast Transport. He now works for Maryland-based Gryphon Scientific as a Senior Analyst, focusing on national security solutions.

Jesse Sloman is an analyst at the Center for Strategic and Budgetary Assessments. Prior to joining CSBA, Mr. Sloman worked for the Council on Foreign Relations. He served as an intelligence officer in the Marine Corps from 2009 to 2013 and a civil affairs officer in the Marine Corps Reserve from 2013 to 2016. He is the recipient of the 2012 Major General Michael E. Ennis Award for Literary Excellence.

Timothy A. Walton is a Senior Analyst at the Center for Strategic and Budgetary Assessments. Mr. Walton focuses his research and analysis on trends in future warfare and Asia-Pacific security dynamics. Prior to joining CSBA, Mr. Walton was a Principal of Alios Consulting Group and an Associate of Delex Consulting, Studies, and Analysis, both defense and business strategy firms.

ACKNOWLEDGMENTS

The opinions and analysis in this study are those of the authors, but draw from the results of an integrated series of workshops, wargames, and exercises. Any shortcomings, however, are solely the responsibility of the authors. This study benefited greatly from the independent reviews of Karl Hasslinger, Dr. Frank Hoffman, and Steven Anderson. The authors would like to thank Maureen Smolskis, Michelle Shevin-Coetzee, and Ryan Boone for their terrific work on the graphics for this report, without which the concepts would be much more difficult to explain. We also want to thank CDR Robert Wells, LCDR April Bakken, Dr. Renee Fye, William Hardy, James Goodheart, and Patrick Nagel for their assistance on the logistics analysis. Most importantly, the authors would like to thank Kamilla Gunzinger for her infinite patience and expert editing and production to get this report completed on time.

CSBA receives funding from a broad and diverse group of funders, including private foundations, government agencies, and corporations. A complete list of these organizations can be found on our web site at <http://csbaonline.org/about/contributors>.

Cover Photo: *America*-class LHA 6 courtesy of Huntington Ingalls Industries.

Contents

EXECUTIVE SUMMARY	I
A New Strategic Approach	i
New Operating Concepts	ii
Changing the Deployed Fleet	iii
A Revised Naval Posture	iv
New Force Packages, Platforms, and Unmanned Systems	v
Changes to Readiness and Training Cycles	vi
Composition and Costs of the Proposed Fleet	vii
Implementing the Proposed Fleet Architecture	ix
Conclusion	ix
CHAPTER 1: INTRODUCTION	1
A Changing Strategic Environment	1
Shifting from Efficiency to Effectiveness	3
Developing a New Fleet Architecture	5
Sustaining American Competitive Advantage	8
CHAPTER 2: THE EMERGING GREAT POWER COMPETITION	9
The Imperative to Deter Great Power Conflict	13
Conventional Deterrence in the 21st Century	13
The Role of Naval Forces in Deterrence	15
CHAPTER 3: OPERATING CONCEPTS AND WARFIGHTING APPROACHES OF THE FUTURE FLEET	17
Implications for Missions and Concepts	18
Air and Missile Defense	19
Electromagnetic Spectrum Warfare	23
Anti-Submarine Warfare	26
Undersea Warfare	30
Surface and Strike Warfare	32
Mine Warfare	33
Amphibious Operations	35
Implications for Fleet Architecture	40
CHAPTER 4: THE ORGANIZATION OF THE DEPLOYED FLEET—THE DETERRENCE FORCE AND THE MANEUVER FORCE	41
The Fleet of Today	41
A New Structure for the Fleet	44
The Deterrence Force	46
The Maneuver Force	48
CHAPTER 5: NAVAL POSTURE	49
North and South America Deterrence Force	50
Northern Europe Deterrence Force	51
Mediterranean Sea and West Africa Deterrence Force	54

Western Indian Ocean and Persian Gulf Deterrence Force	58
Indian Ocean Deterrence Force	60
East China Sea and South China Sea Deterrence Force	60
Western Pacific and Philippine Sea Deterrence Force	62
Arctic Deterrence Force	65
Maneuver Force	65
Logistics and Support Forces	67
CHAPTER 6: NEW SHIPS, UNMANNED VEHICLES, WEAPONS, SENSORS, AND MISSION SYSTEMS . . .	71
Aircraft Carriers	71
Submarines	73
Unmanned Underwater Vehicles	74
Surface Combatants	77
Unmanned Surface Vehicles	79
Amphibious Vessels	80
CLF Vessels	81
Unmanned Vehicle Support Vessels/Tenders	83
Salvage Ships	84
Weapons, Sensors, and Mission Systems	84
CHAPTER 7: IMPLICATIONS FOR NAVAL AVIATION	91
Maneuver Force CVW Missions	91
CVW Organization	95
Composition of Maneuver Force CVWs	96
Deterrence Force CSG CVW	97
CVL Air Wings	97
Implications for Maritime Patrol Aircraft (MPA)	98
CHAPTER 8: READINESS AND TRAINING CYCLES	101
Deterrence Force	104
Maneuver Force	106
Maintenance Industrial Base Implications	107
CHAPTER 9: COMPOSITION OF THE PROPOSED FLEET AND ITS IMPLEMENTATION	109
Implementing the Proposed Fleet Architecture	111
Ship Construction by Ship Type	115
Summary	121
CHAPTER 10: CONCLUSION AND RECOMMENDATIONS	123
Next Steps	125
In Conclusion	126
APPENDIX A	128
APPENDIX B	130
APPENDIX C	131
LIST OF ACRONYMS	134

FIGURES

FIGURE 1: FLEET ARCHITECTURE STUDY METHODOLOGY	6
FIGURE 2: RUSSIA'S RECONNAISSANCE-STRIKE COMPLEX	11
FIGURE 3: CHINA'S RECONNAISSANCE-STRIKE COMPLEX	12
FIGURE 4: NEW AIR AND MISSILE DEFENSE CONCEPT	20
FIGURE 5: DEFENSIVE CAPACITY OF A DDG USING NEW AMD CONCEPT	22
FIGURE 6: SUCCESSFUL ENGAGEMENTS FOR NEW DEFENSIVE SYSTEMS	23
FIGURE 7: EMS WARFARE TO COUNTER ADVERSARY ISR.	24
FIGURE 8: EMS WARFARE LOW-TO-NO POWER SENSING OPERATIONS	25
FIGURE 9: NEW OFFENSIVE ASW CONCEPTS	28
FIGURE 10: NEW DEFENSIVE ASW CONCEPTS	29
FIGURE 11: FUTURE UNDERSEA OPERATIONS	31
FIGURE 12: COORDINATED ANTI-SURFACE AND ANTI-SUBMARINE OPERATIONS.	33
FIGURE 13: MINE LAYING AND CLEARING OPERATIONS.	34
FIGURE 14: ESTABLISHING EABS IN CONTESTED AREAS.	37
FIGURE 15: NUMBER OF WEAPONS NEEDED TO DEFEAT EAB DEFENSES	38
FIGURE 16: USE OF EABS TO CONTEST ACCESS ACROSS A LITTORAL AREA	39
FIGURE 17: AMPHIBIOUS RAIDS IN CONTESTED AREAS	40
FIGURE 18: AVERAGE DEPLOYED U.S. NAVAL PRESENCE IN 2015	42
FIGURE 19: NAVAL PRESENCE AND FLEET SIZE SINCE 1998	43
FIGURE 20: COMPARISON OF OFFENSIVE WEAPONS CAPACITY IN THE WESTERN PACIFIC	45
FIGURE 21: DETERRENCE FORCE REGIONS	47
FIGURE 22: NORTHERN EUROPE BASING	54
FIGURE 23: MEDITERRANEAN SEA BASING	57
FIGURE 24: MIDDLE EAST BASING	60
FIGURE 25: EAST ASIA BASING	64
FIGURE 26: DETERRENCE FORCE LOGISTICS OPERATIONS	68
FIGURE 27: WARTIME LOGISTICS FORCE POSTURE.	68
FIGURE 28: CVN-78 USS GERALD R. FORD.	72
FIGURE 29: CV-41 USS MIDWAY	73
FIGURE 30: BOEING ECHO VOYAGER XLUUV	74
FIGURE 31: GLIDER UNMANNED VEHICLE	75

FIGURE 32: RIPTIDE MICRO UUV	76
FIGURE 33: LCS-1 USS FREEDOM	77
FIGURE 34: EGYPT’S AMBASSADOR-CLASS FAST MISSILE CRAFT (POTENTIAL FUTURE U.S. PATROL VESSEL).	78
FIGURE 35: DARPA SEA HUNTER XLUSV.	80
FIGURE 36: LX(R) AMPHIBIOUS WARFARE SHIP.	80
FIGURE 37: TANKER MT EVERGREEN STATE (T-AOT-5209)	81
FIGURE 38: EPF (NEAR-TERM UNMANNED VEHICLE SUPPORT VESSEL)	82
FIGURE 39: SUBMARINE TENDER USS EMORY S. LAND (AS-39)	83
FIGURE 40: ESB (NEAR-TERM PATROL VESSEL TENDER)	84
FIGURE 41: MALD DECOY	86
FIGURE 42: MK-18 UNMANNED UNDERWATER VEHICLE	88
FIGURE 43: MANEUVER FORCE CVW RANGE NEEDED TO REACH TARGETS THROUGHOUT THE EAST OR SOUTH CHINA WITHIN 2 DAYS	92
FIGURE 44: COMPOSITION OF THE COMBINED MANEUVER FORCE CVW.	97
FIGURE 45: COMPOSITION OF 3- AND 4-SHIP ARG ACES	98
FIGURE 46: DARPA TERN MALE UAV.	99
FIGURE 47: CURRENT NAVY READINESS CYCLES	102
FIGURE 48: DETERRENCE FORCE READINESS CYCLE (SINGLE-CREWED UNITS)	104
FIGURE 49: DETERRENCE FORCE READINESS CYCLE (MULTI-CREWED UNITS)	105
FIGURE 50: MANEUVER FORCE READINESS CYCLE.	106
FIGURE 51: SHIPBUILDING COSTS FOR PROPOSED ARCHITECTURE.	112
FIGURE 52: O&M COSTS FOR PROPOSED ARCHITECTURE.	113
FIGURE 53: BATTLE FORCE INVENTORY RESULTING THE ALTERNATIVE SHIPBUILDING PLAN.	115
FIGURE 54: LARGE SURFACE COMBATANT INVENTORY UNDER THE ALTERNATIVE SHIPBUILDING PLAN.	116
FIGURE 55: SMALL SURFACE COMBATANT INVENTORY UNDER THE ALTERNATIVE SHIPBUILDING PLAN.	117
FIGURE 56: U.S. SUBMARINE PRODUCTION 1975–1998.	118
FIGURE 57: SSN INVENTORY UNDER THE ALTERNATIVE SHIPBUILDING PLAN	119
FIGURE 58: LPD AND LX(R) INVENTORY UNDER THE ALTERNATIVE SHIPBUILDING PLAN.	120

TABLES

TABLE 1: EXPLANATION OF DETERRENCE FORCE TABLES	50
TABLE 2: AMERICAS DETERRENCE FORCE COMPOSITION	51
TABLE 3: NORTHERN EUROPE DETERRENCE FORCE COMPOSITION	53
TABLE 4: MEDITERRANEAN SEA AND WEST AFRICA DETERRENCE FORCE COMPOSITION	55
TABLE 5: WESTERN INDIAN OCEAN AND PERSIAN GULF DETERRENCE FORCE COMPOSITION	59
TABLE 6: SOUTH AND EAST CHINA SEA DETERRENCE FORCE COMPOSITION	61
TABLE 7: WESTERN PACIFIC/PHILIPPINE SEA DETERRENCE FORCE COMPOSITION	63
TABLE 8: ARCTIC DETERRENCE FORCE	65
TABLE 9: MANEUVER FORCE COMPOSITION	66
TABLE 10: COMPARISON OF CLF MINIMUM WARTIME AND PEACETIME REQUIREMENTS	69
TABLE 11: COMPOSITION OF THE PROPOSED FLEET	110
TABLE 12: SHIPBUILDING PLAN EXCURSIONS	114
TABLE 13: SUBMARINE CONSTRUCTION EXCURSIONS	118
TABLE 14: CLF CONSTRUCTION EXCURSIONS.	121

Executive Summary

The United States is entering an era in which it will face a very different set of security challenges than it has since the Cold War. Great power competitors such as China and Russia increased their military capabilities over the last two decades and now appear willing to challenge the international order. They are likely, over the next 15 years, to replace transnational terrorism as the primary concern of U.S. military planners. The challenges of great power competition and conflict will require changes to the ships, aircraft, weapons, sensors, basing, and readiness processes of U.S. naval forces. This study explores those implications and proposes a new fleet architecture for the U.S. Navy to develop by the 2030s to address the most important missions for naval forces.

A New Strategic Approach

Since the Berlin Wall fell, naval force structure requirements reflected an expectation that America's main military challenges would come from regional powers such as Iraq, North Korea, Iran, and terrorist groups. Until now, these adversaries lacked the ability to defeat a U.S. ally rapidly or prevent American forces from coming to the ally's defense. Naval force structure investments, therefore, focused on efficiently maintaining a visible presence in important regions, rather than on what would be needed to fight a peer competitor. Even if forces on or near the scene were unable to stop an act of aggression, in-theater naval and other forces could enable the mobilization of a U.S. and allied response to reverse the adversary's gains, as in the 1991 Gulf War, or overthrow the adversary's regime, as in the wars in Kosovo, Afghanistan, or Iraq.

Potential great power adversaries such as China and Russia are improving their capabilities and making it less likely that the mere presence of U.S. forces will deter them. Most significantly, their long-range air defense and strike systems could prevent the United States and its allies from mobilizing a conventional response in an adjacent theater as was done in the lead-up to the wars in Kosovo, Afghanistan, and Iraq. Instead of responding to aggression after the fact, to deter increasingly revisionist great powers U.S. forces will need the capabilities and operational concepts to deny them the objectives of their aggression or to punish them until the aggression stops.

This “deny-and-punish” approach to conventional deterrence is how the United States and its allies countered the Soviet threat during the Cold War, and it has significant implications for fleet architecture. This strategic approach will increase America’s reliance on forward-postured forces—particularly naval forces—that could rapidly interdict aggression and conduct attacks on targets the enemy values to compel the aggression to stop. Naval units at sea are less subject to host nation restrictions than air and ground forces and give the United States the ability to act unilaterally, reducing opportunities for an aggressor to pressure neighboring countries into limiting an American response. Navies can also lend themselves to more proportional, tailored responses since each ship is an independent, self-sustaining unit able to deploy in smaller force packages than ground or air forces that require large-footprint shore-based support and force protection.

New Operating Concepts

The return of great power competition suggests dramatic changes to how U.S. naval forces will have to operate by the 2030s. The new operating concepts proposed by this study are designed to conduct the range of missions likely required of naval forces and address the ability of great power competitors to contest areas around their territory. The central objective of these concepts is enabling U.S. naval forces to conduct offensive operations against enemy forces engaging in aggression in contested areas and attack targets of value to punish the enemy until aggression stops. The new concepts proposed by the study include:

Air and Missile Defense (AMD): Concepts for increasing air defense capacity so naval forces can conduct initial offensive operations against aggression. Higher air defense capacity could make the required size of enemy salvos too large for the enemy to pursue attacks against distributed naval forces.

Electromagnetic Spectrum (EMS) Warfare: Concepts to degrade the ability of an enemy to target naval forces in contested areas. This would reduce the number of weapons naval forces must defeat and further increase the needed size of enemy salvos.

Anti-Submarine Warfare (ASW): Concepts to find and destroy enemy submarines in contested areas and prevent them from successfully attacking U.S. naval forces.

Undersea Warfare: Concepts for exploiting America’s undersea advantage to conduct offensive operations in the most contested areas near enemy coasts.

Surface and Strike Warfare: Concepts to increase the capacity of naval forces to conduct offensive operations against enemy ships and targets ashore.

Mine Warfare: Concepts to expand the capability and capacity of U.S. naval forces for offensive mining inside contested areas and defeat enemy mining.

Amphibious Operations: Concepts to improve the ability of U.S. naval forces to conduct amphibious raids, establish advance bases, and support anti-air and anti-ship operations inside contested areas.

Each of these concepts assumes a highly contested communications environment that will demand an increased reliance on short-range low probability of intercept/low probability of detection (LPI/LPD) communications and individual commanders leading operations without higher headquarters guidance.

These concepts also employ more unmanned systems to a larger degree than the current force for surveillance, targeting, countering enemy sensors, and delivering weapons. They do not, however, replace manned platforms with unmanned systems to a significant extent. Communications constraints in contested areas will limit the ability of naval forces to command and control unmanned systems over a wide area. Manned platforms will be needed to manage unmanned vehicles and systems and provide the accountability to employ weapons. Moreover, the need for naval forces to focus on deterrence will reduce their ability to use unmanned systems for forward operations, since unmanned vehicles may not have the same deterrent effect as a manned platform and could be more easily neutralized or tampered with by an adversary.

Changing the Deployed Fleet

Changes are needed in the Navy's deployed forces to enable them to deter great power aggression using the new operational concepts described above. Given the short timelines in which aggression could occur and escalate against U.S. allies in East Asia, the Middle East, and Europe, the size and composition of deployed naval forces may make the difference between an adversary being deterred or perceiving an opportunity to act.

To address the challenges posed by Russia and China, the Navy will need to focus on sustaining an effective posture for conventional deterrence rather than an efficient presence to meet near-term operational needs. The posture should address the most significant shortfalls of today's presence: the fact that the current approach does not necessarily position the right capabilities in the right places at the right time to counter great power aggression, and it does not provide the time or ability for the fleet to maintain its material condition, become proficient, and adapt to dynamic and capable adversaries.

This study proposes dividing the deployed fleet into two main groups: "Deterrence Forces" that are organized into discrete regions rather than Combatant Commander (CCDR) areas of responsibility (AOR), and a "Maneuver Force" that is assigned broadly to the Indo–Asia–Pacific theater and composed of the carrier strike groups (CSG) deployed today in the Central and Pacific CCDR AORs. Separating the deployed fleet into these two main groups enables Deterrence Forces to be tailored to their region and improves their ability to prepare and adapt to adversary advancements. And because Deterrence Forces will remain in their region, the Maneuver Force is able to respond to tensions and conflict in any part of the

Indo–Asia–Pacific theater, including the Middle East, without leaving an opening for opportunistic aggression by an adversary seeking to exploit a shift in U.S. focus to the area of conflict.

Operationally, separating the deployed fleet into Deterrence Forces and the Maneuver Force enables commanders to align elements of the fleet with the appropriate mission. Deterrence Forces would consist of surface combatants, submarines, and amphibious ships that can provide prompt, high-capacity fires to deter an adversary seeking a rapid *fait accompli*, such as China or Russia. The Maneuver Force would consist of a Multi-Carrier Task Group designed to deliver sustained combat power at moderate levels over an indefinite period in relief of Deterrence Forces.

A Revised Naval Posture

The size and composition of deployed naval forces, their deployment locations, and their overseas basing create an overall naval posture. In contrast to today’s emphasis on the number of ships present in a CCDR AOR, posture connotes an overall capability to conduct and sustain combat operations. In a period of great power competition, posture—not presence—will need to be the focus of a future fleet architecture.

The Deterrence Force posture in each region is designed to sustain the ability to promptly deny adversaries their likely objectives and attack targets the enemy would value. The characteristics of Deterrence Forces are focused on great powers such as China and Russia, but they address strategically located regional powers such as Iran or North Korea. Perhaps more importantly, Deterrence Force naval posture includes the attributes needed to reassure allies and partners of U.S. resolve and capability to defend their interests. In peacetime, Deterrence Forces would conduct day-to-day operations such as maritime security and disaster response, particularly with the maritime forces of allies and partners, but these missions do not drive the composition of Deterrence Forces.

This study proposes Deterrence Forces to be deployed in each of the following areas, composed of forces packages designed to implement the operating concepts described above.

- North and South America;
- Northern Europe, including the Northern Atlantic, North Sea, and Baltic Sea;
- Mediterranean Sea and West Africa;
- Western Indian Ocean and Persian Gulf;
- Central Indian Ocean;
- East China Sea;
- South China Sea;

- Western Pacific Ocean; and
- Arctic Ocean.

The new fleet architecture includes two types of forward basing in each region. *Forward-based* forces are homeported in the region, such as Forward Deployed Naval Forces (FDNF) in Japan or Spain today, with their crews and dependents living in the region near the homeport. *Forward-stationed* forces use rotational crews from the continental United States (CONUS) to operate platforms that remain forward for several crew rotations, similar to how Littoral Combat Ships (LCS) or guided missile submarines (SSGN) are crewed today.

Deployed forces will also include the Maneuver Force, consisting of two CSGs and the Maritime Prepositioning Force deployed in the Indo–Asia–Pacific region. The Maneuver Force will conduct exercises and experimentation and respond to heightened tension and aggression throughout the theater.

New Force Packages, Platforms, and Unmanned Systems

Executing the operating concepts above in highly contested environments as part of the Deterrence and Maneuver Forces will require new naval force packages as well as some new platforms and payloads. These include:

Carrier Strike Groups consisting of a nuclear aircraft carrier (CVN) and its embarked carrier air wing (CVW), two guided missile destroyers (DDG), and two guided missile frigates (FFG).

Counter-ISR (intelligence, surveillance, and reconnaissance) Groups of an FFG for command and control with an onboard medium-altitude long endurance (MALE) unmanned aerial vehicle (UAV) to act as a communications relay. An unmanned vehicle support vessel would carry several Common Unmanned Surface Vehicles (CUSV) for decoy and jamming missions against airborne sensors and missiles; it would also support two Extra-Large Unmanned Surface Vehicles (XLUSV) with large electronic spoofing and jamming systems.

ASW Groups with an FFG, Transportable Reliable Acoustic Path System (TRAPS) passive sonar sensors, an ocean surveillance ship (T-AGOS) with active low frequency (LF) sonar, and glider or powered Extra-Large Unmanned Underwater Vehicles (XLUUV) with passive towed arrays. The groups would include MALE UAVs from the FFG and two P-8As to track and engage submarines.

Offensive Mine Warfare Groups consisting of an FFG for command and control and two to three XLUUVs equipped with smart mines. The XLUUVs would be based ashore or hosted by an unmanned vehicle support vessel in the region.

Surface Action Groups (SAG) of three surface combatants (a DDG and two FFGs), each with an embarked helicopter and two MALE UAVs, in addition to two XLUSVs employing a signals intelligence (SIGINT) package and towed array for passive targeting.

Littoral Combat Groups consisting of an FFG with medium-range air defense capabilities and three MALE UAVs for passive targeting and three patrol vessels equipped with long-range anti-ship/strike missiles for engaging targets at sea and ashore.

The Amphibious Ready Group (ARG) of a light aircraft carrier (CVL), an amphibious transport dock (LPD), and two next-generation dock landing ships (LX(R)). The CVL would initially be a legacy LHA/LHD, but eventually replaced by a purpose-built 40,000- to 60,000-ton CVL with catapults and arresting gear.

Unmanned Vehicle Squadrons including an unmanned vehicle support vessel with several CUSVs, MALE UAVs, three to six XLUSVs, and three to six XLUUVs to support ASW, counter-ISR, mining, mine clearing, and surface warfare (SUW) operations. Initially, unmanned vehicle support vessels would be Expeditionary Fast Transports (EPF) or Expeditionary Sea Bases (ESB). These would be replaced by purpose-built vessels as they reach the end of their service lives.

Crisis Response Groups consisting of an FFG and an LPD or LX(R) with rotary wing logistics and attack aircraft, ship-to-shore connectors, and MALE UAVs for ISR and communications.

Mine Countermeasures Groups combining an aviation-capable unmanned vehicle support ship with three to six CUSVs towing minehunting sonars, two or more XLUSVs to tow minesweeping gear and deploy mine neutralization micro unmanned underwater vehicles (UUV), and two or more MALE UAVs to find shallow mines with laser and electro-optical/infrared (EO/IR) sensors.

The deployed posture proposed by this fleet architecture incorporates force packages appropriate to the operations needed in each region to deny and punish aggression or conduct likely steady-state operations.

Changes to Readiness and Training Cycles

The number of each type of unit needed in the overall fleet architecture results from the number deployed at any given time and the rotational readiness cycle that prepares them for deployment. For example, a unit that deploys for 6 months of each 2-year cycle will need at least four units to maintain one continuously deployed.

U.S. naval forces currently operate in rotational cycles consisting of deployments, maintenance, training, and certification for the next deployment. Different platform types use different rotational cycles based on their maintenance requirements and complexity of training. Rotational cycles also differ between those based in CONUS and those based

overseas. The proposed fleet architecture proposes changes to these readiness cycles to improve the ability of fleet units to learn, experiment, adapt, and provide more time for maintenance of platforms and systems between deployments.

Deterrence Forces will use a higher operational tempo (OPTEMPO) readiness cycle to reduce the number of platforms needed to maintain the required posture and increase their operational proficiency. To enable them to train and adapt, however, Deterrence Forces will limit their operational time to 50 percent. This will also provide more time for maintenance to be conducted between underway periods compared to today's FDNF, which operates about two-thirds of the time.

As with today's FDNF, Deterrence Forces would maintain their operational proficiency in large part by their higher OPTEMPO. Compared with today's FDNF, however, Deterrence Forces would have longer annual training periods and be focused on a much narrower geography, a smaller set of threats, fewer adversary objectives, and more specific alliance contributions. This would enable each Deterrence Force to become more knowledgeable on their respective region compared to today's FDNF.

Compared to the Deterrence Force, the Maneuver Force will need to be prepared for a wider range of possible operational environments, more potential adversaries, a larger number of alliance relationships, and a higher likelihood of being faced with high-intensity sustained combat. Therefore, it would employ a lower OPTEMPO readiness cycle like today's CONUS-based forces to provide more time to prepare for deployment compared to the Deterrence Forces.

Composition and Costs of the Proposed Fleet

This study translates naval posture into an overall number of ships and aircraft required in the proposed fleet architecture. In addition to supporting the rotational readiness cycle, the architecture includes additional ships to account for the time ships are in transit and the long-term maintenance that takes ships out of their readiness cycle. Further, the study assumes that, consistent with the Navy's current Force Structure Assessment (FSA), the rotation base of non-deployed forces in the readiness cycle is sufficient for wartime surge requirements

The table below depicts the proposed fleet architecture with each of these factors considered. It includes 382 manned ships, of which 340 fall under the Navy's battle force counting rules. Moreover, it includes extra-large unmanned vehicles (XLUSV and XLUUV), and ground-based patrol aircraft. Shipborne aircraft such as CVW aircraft, Tactical Exploitable Reconnaissance Node (TERN) UAVs, and helicopters are assumed to be included with the ships on which they would deploy.

COMPOSITION OF THE PROPOSED FLEET¹

	Total Fleet Required
CVN	12
CVL	10
DDG-1000	3
DDG	71
FFG	71
Patrol Vessel	42
SSN	66
SSBN	12
Small Deck Amphibious Ships (LPD, LX(R))	29
Large Oiler (T-AOE)	26
Large Dry Stores Ship (T-AKE)	4
Unmanned Vehicle Support Vessel	14
Afloat Forward Staging Base	2
Large Dry Stores Transport Ship w/VLS	1
Tender	5
Salvage/Fleet Tug	6
Oceanographic Research Ship	5
Command Ship	3
Total Battle Force Ships (using current counting rules)	340
Total Fleet (including patrol vessels)	382
XLUSV	40
XLUUV	40
MQ-4 Detachment (3 A/C)	14
P-8 Detachment (3 A/C)	44
Unmanned Vehicle Squadron	6

.....

¹ The totals at the bottom of this chart use current counting rules or total number of manned ships. The current counting rules do not count ships that do not directly support combat operations, such as sealift ships or hospital ships. The current rules also do not include ships that are not able to move themselves to their deployed area and must instead be carried there by a lift ship, such as today's patrol coastal (PC) or the proposed patrol vessels. See Secretary of the Navy, *General Guidance for The Classification of Naval Vessels and Battle Force Ship Counting Procedures*, SECNAVINST 5030.8C (Washington, DC: Department of the Navy, June 14, 2016), p. 2.

Implementing the Proposed Fleet Architecture

The proposed architecture will likely cost about 10–20 percent more to build, operate, and sustain than the Navy’s planned fleet. The shipbuilding industrial base could reach the objective number for each ship type of the proposed fleet architecture in the 2030s, but the Navy will need to modify its shipbuilding plans to achieve the size and composition of the proposed fleet architecture.

The alternative shipbuilding plan that delivers the proposed fleet architecture will cost an average of \$23.2 billion per year, 18 percent more than the \$19.7 billion annual cost of the draft 30-year shipbuilding plan associated with the President’s Budget for FY 2017 (PB17).² If the Navy expands the Combat Logistics Force (CLF) fleet to meet the wartime demands of the proposed fleet architecture, the average annual cost rises to \$23.6 billion, 20 percent greater than the PB17 plan. The operations and maintenance (O&M) costs associated with the proposed fleet architecture plan will cost an average of \$16.5 billion per year, 14 percent more than the \$14.6 billion associated with the PB17 budget.³

The alternative shipbuilding plan balances the need to reach the proposed architecture with the imperative to manage costs. For many ship types, the plan assumes that existing platforms, with modest modification, will support the new operational concepts of the proposed architecture. The plan replaces these platforms at the end of their service lives with new, purpose-built ships and aircraft designed for their missions in the new architecture.

Conclusion

Today’s Navy emphasizes efficiency over effectiveness. This was a rational reaction to the presumed end of great power competition with the fall of the Soviet Union. In the decades that followed, the U.S. Navy developed a process to affordably maintain a continuous presence of deployed forces in each CCDR AOR. These forces may not be able to stop aggression by regional powers, but could support an eventual response by follow-on forces as was done in Kosovo, Iraq, and Libya.

This approach to conventional deterrence will not likely work against the potential great power aggressors of the 2030s, who will have much greater military capabilities than past regional adversaries and probably seek a quick, decisive victory over their adversaries. Efforts to reverse the results of aggression after the fact would require a much larger conflict and would likely have global consequences that would create international pressure to reach a quick settlement.

2 Chief of Naval Operations (CNO), *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2017* (Washington, DC: Department of the Navy, July 2016), p. 7.

3 For more information regarding the calculations, see Appendix A.

To be deterred in the 2030s, aggressors must be presented with the possibility that their goals will be denied or that the immediate costs to pursue them will be prohibitively high. The architecture proposed by this report would achieve that effect with more powerful day-to-day Deterrence Forces tailored by region. Bolstering that immediate deterrent would be the Maneuver Force, which in peacetime would hone its skills in multi-carrier, cross-domain, high-end warfare. These two forces would be comprised of some of the same elements, but packaged and supported differently.

This proposed fleet architecture emphasizes effectiveness over efficiency. Built on new operating concepts the Navy is already pursuing and incorporating a new approach to conventional deterrence, the new architecture offers the prospect of protecting and sustaining America's security and prosperity, as well as that of our friends and allies around the world, in the decades ahead. Deterring great power war demands the readiness to contest and win it—and a fleet that supports this approach.

CHAPTER 1

Introduction

The United States is entering an era in which it will face a very different set of security challenges than it has since the Cold War. After the collapse of the Soviet Union, the United States found itself the world's lone superpower, with unmatched military power and political influence. That superiority has deterred adversary states from large-scale aggression against the United States and its allies. However, the September 11, 2001 terrorist attacks showed that stateless, transnational networks could exploit technology to achieve effects previously only possible by a state military. As a result, the United States, its allies, and its partners have waged a series of campaigns against an evolving array of insurgents and irregular forces over the past 15 years.

While the United States was engaged in wars across the Middle East, great power competitors such as China and Russia increased their military capabilities and now appear willing to challenge the international order. It is likely that, in the next 15 years, the threat posed by non-state adversaries will be overshadowed by the far greater challenges of great power competition and conflict. This will require changes to the ships, aircraft, weapons, sensors, basing, and readiness processes of U.S. naval forces.

A Changing Strategic Environment

Since the end of the Cold War, naval force structure requirements have reflected an expectation that America's main military challenges would come from regional powers such as Iraq, North Korea, and Iran, as well as from non-state actors such as terrorist groups. Until now, these adversaries lacked the ability to defeat a U.S. ally rapidly or prevent American forces from coming to the ally's defense. Naval force structure investments, therefore, focused on efficiently maintaining a presence in important regions, rather than on capabilities needed to fight a highly capable adversary.

Against regional and non-state adversaries, the mere presence of U.S. forces was assumed to be sufficient to deter or respond to aggression. Even if forces on or near the scene were unable

to stop the aggression, in-theater naval and other forces could enable the mobilization of a U.S. and allied response to reverse the adversary's gains, as in the 1991 Gulf War, or overthrow the adversary's regime, as in the recent wars in Kosovo, Afghanistan, or Iraq.

Today's reliance on a delayed, but massive, response to aggression may not effectively deter great powers such as China and Russia. Russia invaded neighboring Georgia in 2008 and Ukraine in 2014—countries that are friendly with the United States. It has also threatened fellow members of the North Atlantic Treaty Organization (NATO). China reserves the right to use force against Taiwan and is modernizing its military to carry out such a mission. In addition, China claims maritime territory exceeding that allowed by the United Nations Convention on the Law of the Sea (UNCLOS), including waters legally controlled by two U.S. allies: Japan and the Republic of the Philippines.

The desire of China and Russia to expand their territory and influence is not new. What is new is their ability to marry a desire to change the international order with the military capabilities (as well as economic and diplomatic strategies) to achieve some of their objectives. After being in decline for nearly two decades after the fall of the Berlin Wall, Russia has been rebuilding its military over the past decade. Although not as large or broadly capable as the Cold War-era Soviet military, Russia's army is highly effective in irregular operations, air defense, surface fires, and electronic warfare. The Russian Federation Navy is not highly capable of overseas "blue water" operations, but it has fielded a new class of corvettes equipped with cruise missiles—four of which attacked targets in Syria more than 1000 nm away, demonstrating Russia's long-range over-the-horizon targeting capability.⁴ Further, Russia's submarine force, long the focus of its navy, includes a new class of very quiet and capable attack submarines, a new nuclear ballistic missile submarine, and a robust undersea reconnaissance program with deep-diving unmanned underwater vehicles and submarines.⁵

China has steadily built up the People's Liberation Army (PLA) over the past 30 years, expanding it from a ground force focused on border and internal security to a full-spectrum military. Today the PLA Navy (PLAN) boasts the second largest fleet in the world, with a large portion of ships built in the last decade. The PLA includes a rapidly modernizing air force in addition to a Rocket Force (formerly the Second Artillery Corps) that deploys a wide array of conventional land-attack and anti-ship ballistic missiles (ASBM) as well as the country's nuclear arsenal. Combined with China's long-range surveillance network of satellites and shore-based radars and sensors, these forces create a formidable reconnaissance-strike

4 Christopher Cavas, "Is Caspian Sea Fleet a Game Changer?" *Defense News*, October 11, 2015, available at <http://www.defensenews.com/story/defense/naval/ships/2015/10/11/caspian-sea-russia-navy-missiles-attack-strike-military-naval-syria-frigate-corvette-lcs-littoral-combat-ship/73671188/>.

5 Kathleen H. Hicks, Andrew Metrick, Lisa Sawyer Samp, and Kathleen Weinberger, *Undersea Warfare in Northern Europe* (Washington, DC: Center for Strategic and International Studies, 2016), pp. 10–12, available at <https://www.csis.org/analysis/undersea-warfare-northern-europe>.

complex that can threaten U.S. and allied forces on or above the water hundreds of miles from China's borders.⁶

The military capabilities that Russia and China have developed and deployed are also being sold to nations such as Iran or North Korea that threaten the interests of the United States, its allies, and its partners. In particular, technologies for nuclear ballistic missiles, ASBMs, anti-ship cruise missiles (ASCM), and long-range radars are enabling these regional powers to develop their own networks to threaten or attack U.S. forces coming to the defense of American allies.

As potential adversaries improve their capabilities, it seems less likely that the mere presence of U.S. forces will deter them. Recent analysis suggests that they could successfully achieve certain limited military objectives before current U.S. presence forces would be able to stop them.⁷ Further, long-range air defense and strike systems could prevent the United States and its allies from mobilizing a conventional response in an adjacent theater as was done in the wars in Iraq, Afghanistan, and Kosovo. To deter great powers from achieving their revisionist goals, U.S. forces will need the capabilities and operational concepts to deny them the objectives of their aggression or punish them, compelling the aggressor to stop—instead of threatening a response after aggression occurs.

Shifting from Efficiency to Effectiveness

Since the end of the Cold War, U.S. naval forces have attacked terrorists and insurgents and supported U.S. conventional deterrence by ensuring access for joint forces intervening against aggression by regional powers. They have also responded to disasters and humanitarian crises and conducted maritime security operations to counter piracy and illicit trafficking. These missions were similar from region to region and hence did not require U.S. naval forces to be tailored for each CCDR AOR. The Navy was able to rely on the central elements of its conventional Cold War force structure—CSGs and ARGs. In response to U.S. strategic guidance, the Navy generally maintained one of each in the U.S. Pacific and Central Command AORs. Augmenting these groups were submarines for ISR; DDGs and cruisers (CG) for ballistic missile defense (BMD); smaller surface combatants for maritime security; and non-combatant ships for humanitarian assistance.

6 Office of Naval Intelligence (ONI), *The PLA Navy: New Capabilities and Missions for the 21st Century* (Washington, DC: ONI, April 9, 2015), pp. 13–25, available at http://www.oni.navy.mil/Portals/12/Intel%20agencies/China_Media/2015_PLA_NAVY_PUB_Print.pdf?ver=2015-12-02-081247-687; and Office of the Secretary of Defense (OSD), *Military and Security Developments Involving the People's Republic of China 2016*, Annual Report to Congress (Washington, DC: DoD, 2016), pp. 22–29, available at <http://www.defense.gov/Portals/1/Documents/pubs/2016%20China%20Military%20Power%20Report.pdf>.

7 David A. Shlapak and Michael Johnson, *Reinforcing Deterrence Along NATO's Eastern Flank: Wargaming the Defense of the Baltics*, RR-1253-A (Santa Monica, CA: RAND Corporation, 2016), p. 1, available at http://www.rand.org/pubs/research_reports/RR1253.html.

The simplicity of this fleet design was complemented by the organizational emphasis on efficiency in the processes the Navy used to prepare forces for deployment. A small menu of force packages such as CSGs and ARGs were prepared for deployment through the Fleet Response Training Plan (FRTTP), which focused on the kinds of operations that forces were likely to conduct on deployment, such as air strikes in Iraq and Afghanistan or counter-piracy operations off the Horn of Africa. Over time, less emphasis was placed on time-consuming training for low-probability, but highly consequential, contingencies such as conflict against a regional or great power.⁸

In a world where competition and conflict with great powers are more likely than in the recent past, the fleet will have to trade efficiency for effectiveness. U.S. naval forces will need to be equipped with more specialized capabilities to prevent or delay aggressors from achieving their objectives rapidly or to punish them immediately to compel the aggression to stop. Ground and air forces can contribute to these operations if they are in the conflict zone, but their overseas presence is small in most regions and increasingly concentrated at large main operating bases that are vulnerable to diplomatic pressure or enemy attack. These forces may not be able to survive or remain effective at the point of conflict to de-escalate a crisis. In contrast, naval forces offer responsiveness, mobility, high readiness, scalability, and the self-defense capability to remain near the adversary's objective.

To deter effectively, naval forces will need to be postured where they can intervene against aggression or attack enemy targets of value with capabilities tailored to the geography, threats, and targets of each region. For example, to deter China from attempting to take the Senkaku Islands from Japan, naval forces would likely need to be deployed in the East China Sea with capabilities that can rapidly attack PLAN surface ships and shore targets without themselves being promptly targeted and destroyed. Similarly, U.S. naval forces may need to be able to intervene rapidly against Russian forces attacking NATO allies in Eastern Europe. Because NATO may take time to respond, and because allies such as the Baltic nations could be quickly overrun due to their limited geographic depth, U.S. naval forces may need to act unilaterally at the onset of hostilities.

The posture and capabilities naval forces will require in the future suggest significant changes to how the fleet deploys. For example, today's approach of using large, high-end platforms such as aircraft carriers to support the whole range of naval operations will not be effective at providing the prompt, survivable, high-capacity firepower that might be required to deter aggression in the South or East China Seas. It may be better to rely upon submarines and surface combatants as the primary instruments of deterrence and reassurance and deploy aircraft carriers from the open ocean where they can maneuver to engage the enemy once aggression occurs.

⁸ Christopher Cavas, "Held up in the Shipyard, Carrier Bush is Under the Gun to Deploy on Time," *Defense News*, August 28, 2016, available at <http://www.defensenews.com/articles/held-up-in-the-shipyard-carrier-bush-is-under-the-gun-to-deploy-on-time>.

Developing a New Fleet Architecture

The changing strategic environment suggests the Navy should reevaluate its force structure requirements. However, the Navy should also change the process by which it develops those

Section 1067 of the 2016 National Defense Authorization Act directed the Secretary of Defense to commission three separate studies to define future fleet architectures for the 2030 timeframe: one by an internal Navy group, one by a Federally Funded Research and Development Center, and one by a non-profit think tank. CSBA was chosen to conduct the latter study. Appendix C contains the full text of the legislation.

requirements through its FSA. The Navy FSA has some inherent limitations that this study addresses in its process for developing a new fleet architecture. Most prominently, the FSA assumes that today's defense strategy and use of naval forces will continue to apply into the future, and it bases its projection of future demands for naval forces on either today's war plans or Global Force Management Allocation Plan

(GFMAP) requirements for steady-state operations. It does not incorporate new strategies, different ships and aircraft, or basing and readiness processes that are not part of today's fleet. Nor, from a broader perspective, does the Navy's planning process integrate evaluations of the components of its fleet architecture—its composition, concepts, posture, and readiness processes—in a holistic manner. As a result, today's approach to requirements development leads to evolutionary solutions that recapitalize the fleet, rather than innovation to address a changing strategic environment. For example, despite Russia's aggression and the growth and modernization of China's military, the U.S. Navy requirement for an approximately 300-ship fleet has remained essentially unchanged since 2007.⁹

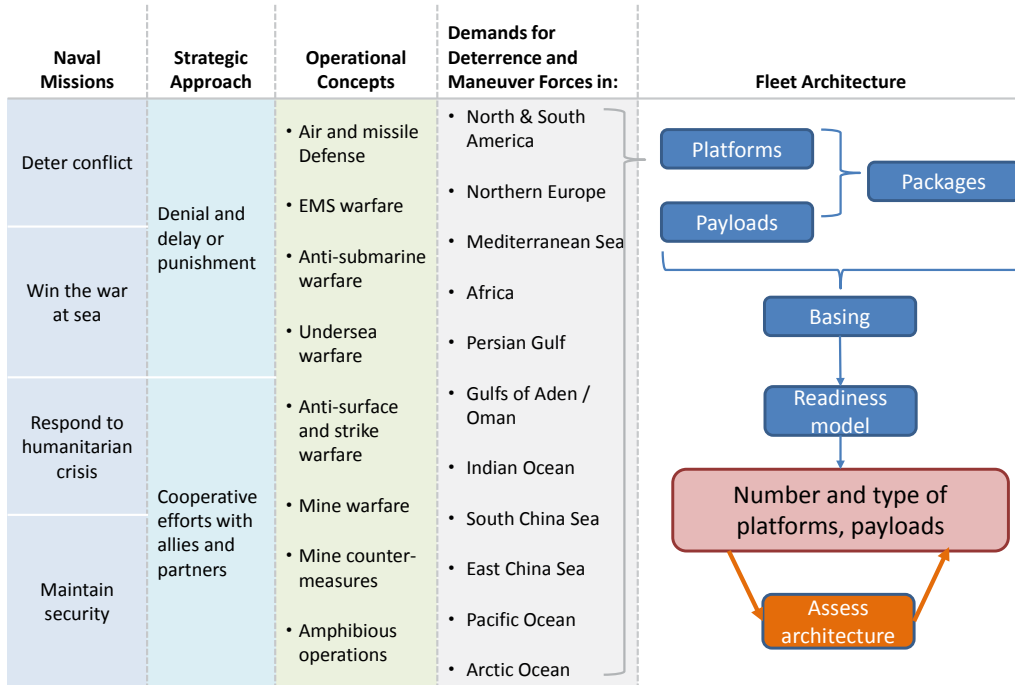
This study proposes a modified version of the FSA process to develop a proposed fleet architecture for the U.S. Navy of 2030. A fleet architecture consists of the material components of the fleet, such as ships, aircraft, weapons, and sensors; the readiness processes that prepare them for deployment; and their basing and deployment posture. These elements are inter-related. For example, how naval forces fight and operate will dictate the kinds of material capabilities they need. The number of ships or aircraft needed in the fleet depends on where they are based and the length of the cycle that prepares them for deployment. And the weapons and sensors they deploy affect the posture needed to ensure U.S. forces can reach and defeat a potential adversary.

To break out of the circular logic of today's FSA process, this study will determine the requirements for the fleet architecture of 2030 not by starting with today's demands on naval forces, but by evaluating the capabilities and posture needed to implement new strategies and operational concepts appropriate to the emerging era of great power competition. The study will

⁹ Ronald O'Rourke, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, RL32665 (Washington, DC: CRS, September 21, 2016), p. 6, available at <https://www.fas.org/sgp/crs/weapons/RL32665.pdf>.

then assess the number and type of ships, aircraft, and mission systems, as well as the readiness cycles and basing needed to provide those capabilities and that posture. Figure 1 depicts the basic methodology for the study.

FIGURE 1: FLEET ARCHITECTURE STUDY METHODOLOGY



The study begins by examining the emerging strategic environment and the missions that will likely be most important for U.S. naval forces in the 2030s. In an era of great power competition, the fleet’s missions will need to focus on deterring and responding to aggression. Other missions, such as maritime security, will need to be assigned a lower priority or shifted to allies and partners. Notably, the approach naval forces take toward deterrence will need to change from one of preparing to reverse the aggressor’s gains after the fact to denying the aggressor its objectives outright or punishing it for the aggression as soon as it occurs. The study then assesses which strategic approaches and operational concepts are needed to conduct those missions under the conditions the future environment is likely to present.

The study then determines the posture of naval capabilities and platforms needed to conduct the most important naval missions in each geographic region using these new strategic approaches and operational concepts. In doing so, the study takes the perspective of a CCDR in the 2030s and develops a posture to address the likely adversary objectives, threats, and vulnerabilities for each region within the CCDR AOR. This regional, rather than AOR-wide, approach enables the posture to address differences in adversary objectives and targets of value between regions. For example, U.S. forces in the East China Sea may need to focus on

denying the PLA's ability to take and hold islands, whereas those in the South China Sea would focus on attacking PLAN ships and submarines; both forces, however, would be deployed in the U.S. Pacific Command AOR. The new naval posture will also reflect the need to have "deterrence" forces forward that are able to conduct short-duration, high-volume offensive operations with little warning against adversaries such as China or Iran and "maneuver" forces outside the immediate vicinity that can conduct sustained combat operations over a longer period of time.

The study develops a proposed fleet architecture of ships, aircraft, sensors, and weapons, as well as the complementary basing and readiness cycles, needed to sustain the day-to-day posture of Deterrence and maneuver naval forces. The proposed fleet architecture will consider platforms and mission systems in today's fleet, and those available in other navies; new basing initiatives under consideration by CCDRs; and modifications to readiness cycles to improve the preparation of naval forces for the challenges in their deployed theater. This architecture will likely be sufficient to support both peacetime and wartime demands. The number of personnel, platforms, and systems needed to sustain a peacetime posture of rotationally deployed forces with adequate time between deployments for rest, training, and maintenance is higher than that needed for wartime surge operations in which all forces that are not in maintenance are available.

In developing a new fleet architecture, this study will pursue the following objectives, which are derived from the Chief of Naval Operations' Design for Maritime Superiority and intended to improve the ability of the fleet to support the U.S. military in a great power competition with China and Russia:¹⁰

- Improve training and preparation through faster incorporation of lessons and learning from real-world operations and experiments;
- Integrate better with allies and partners;
- Provide more options and flexibility in force packages and "kill chains;"
- Develop a plan that is executable fiscally and with the industrial base; and
- Better exploit manned-unmanned teaming.

The resulting architecture was evaluated for its ability to address likely operational scenarios for small-scale confrontations and conflicts through large-scale war using wargames and quantitative analysis. These results of these assessments are included in Chapter 9.

10 John Richardson, *A Design for Maintaining Maritime Superiority* (Washington, DC: Department of the Navy, January 2016), pp. 7–8.

Sustaining American Competitive Advantage

The U.S. Navy is leaving a period in which it was a supporting element of the American military and entering one in which it will form the first line of deterrence and response against great power aggression. To sustain America's security commitments in this environment, the fleet must become more lethal, survivable, focused, and tailored for the operations it is likely to face. The proposed fleet architecture of this study will support these needs and do so within reasonable fiscal constraints. If the Navy does not evolve, the position of the United States in these competitions will erode, along with the diplomatic and economic benefits it receives from its current state of primacy.

CHAPTER 2

The Emerging Great Power Competition

During the quarter century since the collapse of the Soviet Union in 1991, the U.S. military has based its planning and operations on challenges from regional powers and transnational terrorist threats. By some measures, however, the “unipolar moment” of the United States as the sole superpower is ending.¹¹ The capability and willingness of great powers such as China and Russia to challenge the status quo are increasing, and the United States will need to shift the focus of its military operations from maintaining security against these manageable threats to deterring aggression by highly capable adversaries.

In recent decades, globalization—the free flow of information, goods, and services across the global commons—served as an engine of economic growth that lifted hundreds of millions out of poverty and brought prosperity to dozens of countries. The United States underwrote globalization in large part with the preponderance of military and economic power it gained from access to labor, capital, and markets during the previous wave of globalization in the late 19th century. The current wave of globalization spurred the rapid emergence of new powers such as China and India; indeed, no state has benefited more from globalization than China. Now that China is joining the ranks of great powers, however, its leaders increasingly seek to revise the rules, norms, and institutions that govern the world order to suit their interests.

11 Charles Krauthammer, “The Unipolar Moment,” *Foreign Affairs* 70, no. 1, 1990/1991, pp. 23–33.

Globalization affects military affairs as well. The increasing commercial availability of militarily relevant technologies lowers the barriers for states and non-state actors to acquire and develop advanced weapons systems.¹² Proliferation allows them to counter traditional areas of U.S. military advantage, such as the ability to project and sustain military power around the world. This, in turn, threatens to undermine U.S. efforts to deter adversaries and reassure allies. For example, countries such as China or Russia are fielding advanced military capabilities including long-range radars, air defense systems, satellite-based sensors, and long-range cruise and ballistic missiles to prevent or delay U.S. or allied forces from intervening in their regions. Figures 2 and 3 depict these “reconnaissance-strike complexes” for Russia and China, respectively.¹³

Reconnaissance-strike complexes can help protect adversary operations in peacetime by requiring an American response to be more escalatory. Increasingly, Russia and China are turning to tactics below the threshold of overt conflict, including the use of legal warfare, computer-based network attacks and espionage, disinformation via social media, militias, criminal organizations, militarized coast guards, and fishing fleets.¹⁴ These so-called “gray zone” tactics may represent an attempt in China’s case to pursue its interests in the near-term without drawing a full-scale response by the United States, its allies, and others.¹⁵ In contrast, gray zone approaches are a long-standing component of Soviet and Russian military and intelligence operations. With both countries, these tactics place the onus on the United States to either respond with potentially escalatory effects to overcome the reconnaissance-strike complex or accept a creeping revision of the status quo. To date, U.S. forces and their allies have not fielded operating concepts or systems able to effectively counter gray zone aggression.

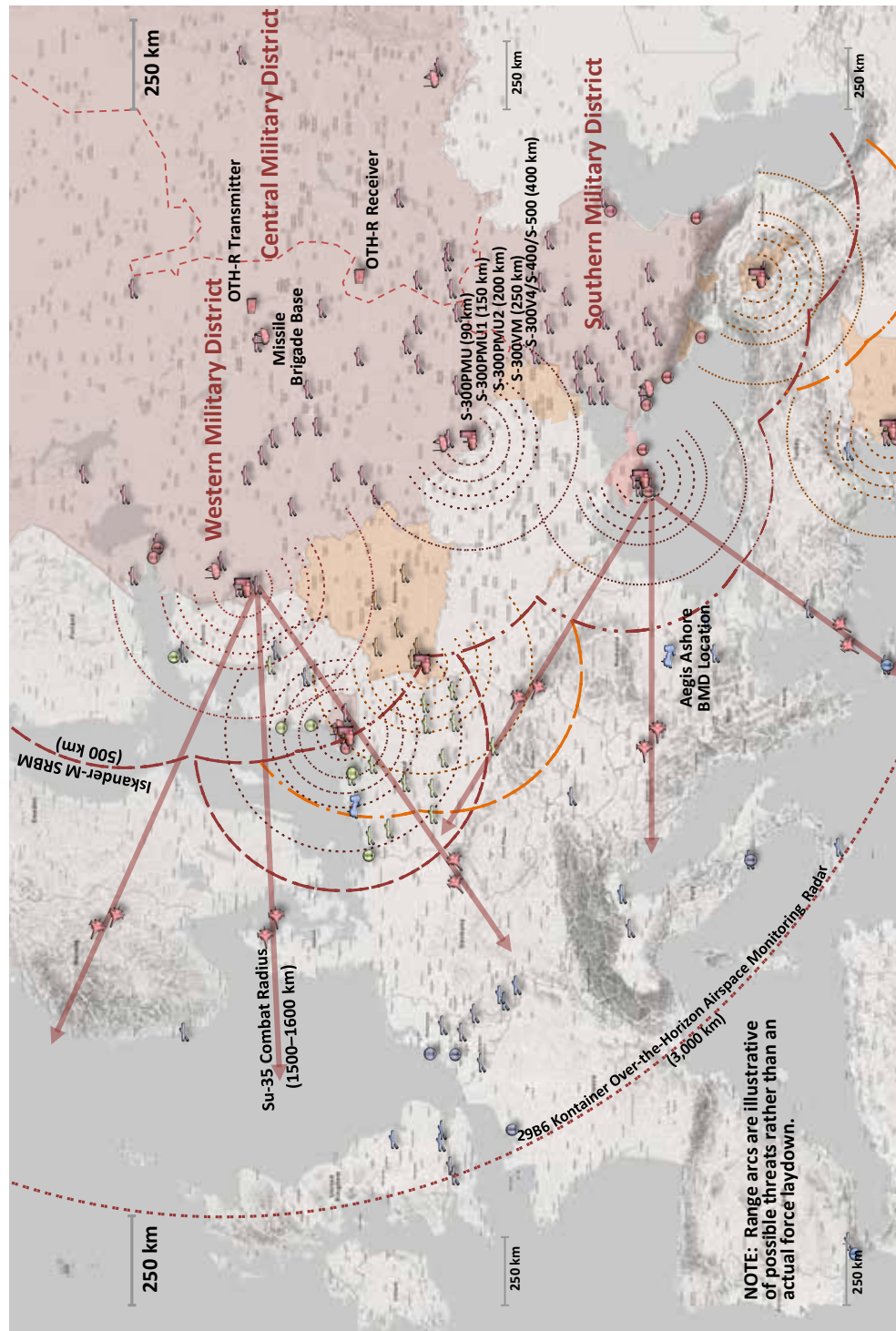
12 See Barry D. Watts, *Six Decades of Guided Munitions and Battle Networks: Progress and Prospects* (Washington, DC: Center for Strategic and Budgetary Assessments, 2007), pp. 3–4.

13 Mary C. FitzGerald, *Marshal Ogarkov and the New Revolution in Soviet Military Affairs* (Alexandria, VA: Center for Naval Analyses, 1987); and Andrew F. Krepinevich, *The Military-Technical Revolution: A Preliminary Assessment* (Washington, DC: Center for Strategic and Budgetary Assessments, 2002).

14 Michael J. Mazarr, *Mastering the Gray Zone: Understanding a Changing Era of Conflict* (Carlisle, PA: Strategic Studies Institute, 2015), p. 4, available at <http://www.strategicstudiesinstitute.army.mil/pubs/display.cfm?pubID=1303>.

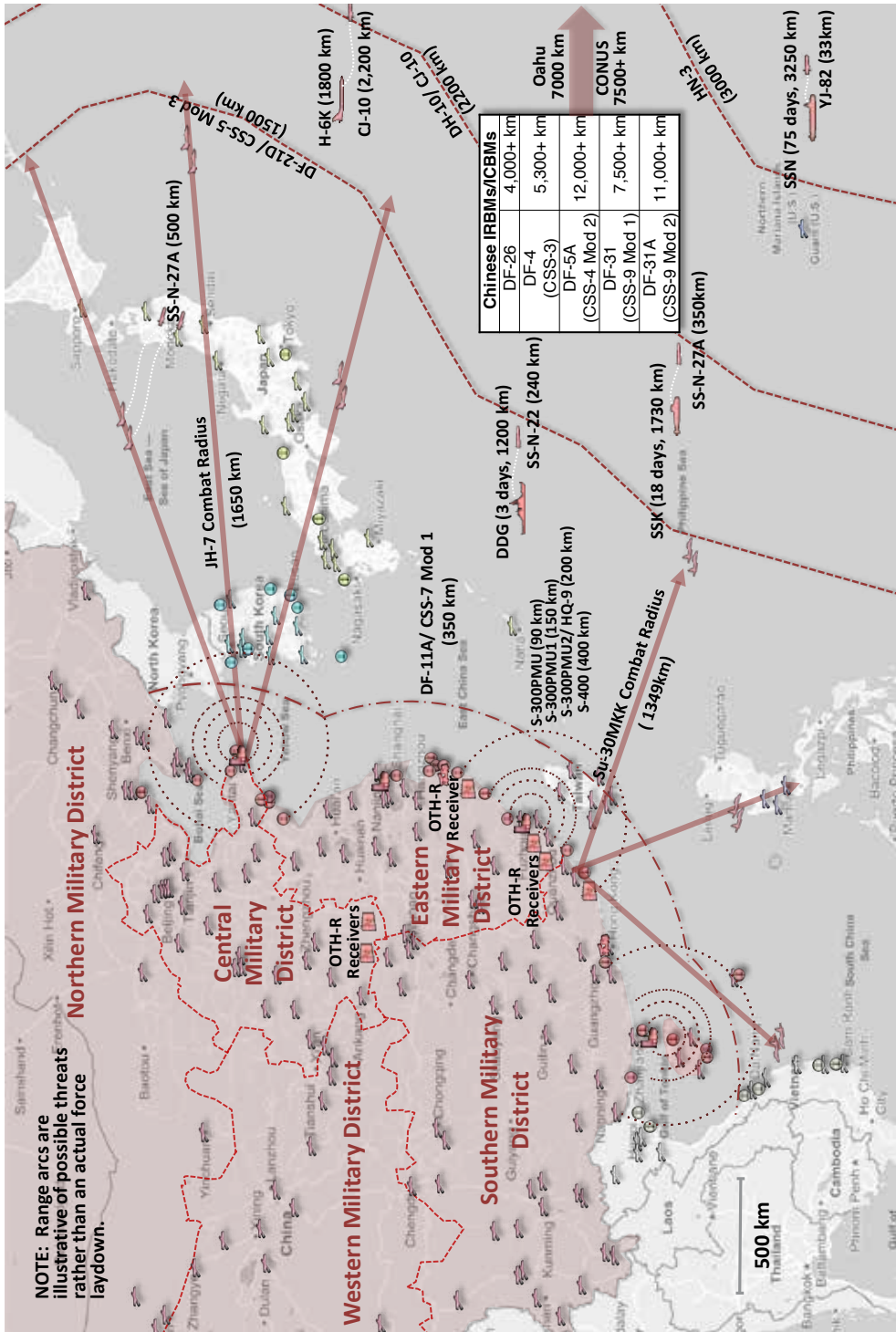
15 As Hal Brands noted, “Gray zone conflict is best understood as activity that is coercive and aggressive in nature, but that is deliberately designed to remain below the threshold of conventional military conflict and open interstate war. Gray zone approaches are mostly the province of revisionist powers—those actors that seek to modify some aspect of the existing international environment—and the goal is to reap gains, whether territorial or otherwise, that are normally associated with victory in war. Yet gray zone approaches are meant to achieve those gains without escalating to overt warfare, without crossing established red-lines, and thus without exposing the practitioner to the penalties and risks that such escalation might bring. Gray zone challenges are thus inherently ambiguous in nature. . . . They represent that coercion that is, to varying degrees, disguised; they eat away at the status quo one nibble at a time.” Hal Brands, “Paradoxes of the Gray Zone,” Foreign Policy Research Institute, *E-Notes*, February 5, 2016, available at <http://www.fpri.org/article/2016/02/paradoxes-gray-zone/>.

FIGURE 2: RUSSIA'S RECONNAISSANCE-STRIKE COMPLEX¹⁶



16 Data to build this chart was derived from IHS Jane's in January 2016.

FIGURE 3: CHINA'S RECONNAISSANCE-STRIKE COMPLEX¹⁷



17 Data to build this chart derived from OSD, *Military and Security Developments Involving the People's Republic of China* 2016.

The Imperative to Deter Great Power Conflict

The resort to gray zone tactics represents at least an implicit recognition by China and Russia that the costs of great power conflict would be enormous. It is likely that such a war would not only cause significant loss of life, but could also bring about the collapse of the international political and economic system. The United States, in large part, designed the rules, regimes, and institutions of this system, and it is the source from which America draws its power, influence, and ability to defend its way of life.¹⁸ Further, access to capital and markets also has led to the economic and military rise of America's allies and competitors alike. Consequently, it is in the interest of every nation, and particularly the United States, to prevent a war that could damage or destroy the current international political and economic system.

Great power conflict, therefore, will represent the most significant threat to the United States in coming decades. In terms of the costs and consequences to the United States, its allies and competitors, and the global economy, other threats such as radical terrorism pale in comparison to those wrought from major power conflict. For example, the First World War directly caused 18 million deaths and contributed to a worldwide flu pandemic that killed 80 million. The ensuing instability in the interwar period bred the conditions for both the Second World War, adding another 75 million deaths, and for the 50-year long nuclear standoff with an illiberal continental power, the Soviet Union. A great power war fought in the so-called second nuclear age could be even more destructive.

This is not to say that the threats posed by terrorism and regional conflict are somehow insignificant. These will continue to be of concern in the future. However, the growing possibility of great power confrontation poses the most consequential threat to the United States and its allies. It should thus form the basis for planning the size, shape, and disposition of the future fleet.

Conventional Deterrence in the 21st Century

As great powers like Russia and China acquire new capabilities, the likelihood that the United States can deter them with the approaches it has used against regional adversaries since the 1990s is diminishing. As demonstrated in Iraq, Bosnia, Kosovo, and Afghanistan, the United States and its allies rely on the threat of a massive, albeit somewhat delayed, response under relatively permissive conditions to reverse the gains of aggression and potentially overthrow the adversary government as a deterrent to further aggression. This "compellence after the fact" approach to deterrence uses forward-deployed forces to enable an eventual response to aggression rather than to stop the aggression outright.

U.S. competitors responded to America's military actions by developing capabilities and strategies to circumvent this approach to deterrence. China and Russia now field

¹⁸ Peter D. Haynes, *Toward a New Maritime Strategy: American Naval Thinking in the Post-Cold War Era* (Annapolis, MD: U.S. Naval Institute Press, 2015), p. 1.

reconnaissance-strike complexes that enable them to threaten U.S. or allied forces attempting to intervene on behalf of a country under attack. Although clearly useful in war, their ability to contest waters, land, and airspace around their regions is even more valuable in peacetime, as it reduces the credibility of U.S. security assurances and the deterrent value of U.S. forces.

Potential adversaries can also exploit geography to degrade the effectiveness of today's U.S. deterrence approach. Their objectives—Taiwan or the Senkakus for China, the Baltic nations for Russia, or the Strait of Hormuz for Iran—are close enough to these states to conduct attacks quickly and with little warning. Proximity also enables them to make up for their small capacity in high-end combat because it reduces the number of forces in rotation needed to sustain operations in the conflict area. Although each has a core group of well-equipped and proficient forces, they lack the multiple rotations of personnel and equipment needed to replace losses, enable maintenance and repair, or address secondary threats that may develop during a conflict. China has a larger military and would be better able to address these force structure demands, but it still relies on a fraction of its force for complex military operations away from home.¹⁹

Given these capabilities and geographic advantages, an aggressor might believe that it could achieve its military objectives before U.S. and allied forces are able to mobilize their massive, albeit delayed, response. An aggressor might further calculate that the international community would be unwilling to support a conventional offensive to dislodge the aggressor, given the number of additional casualties, damage, and disruption the operation would entail, as well as the potential for nuclear escalation. As a result, they may hope to achieve a *fait accompli*, much like Russia achieved with its 2014 annexation of Crimea.²⁰

In the early days of the Cold War, the United States faced a similar challenge. American leaders assessed Warsaw Pact forces could achieve some objectives, such as the occupation of parts of West Germany, before NATO's conventional capabilities could turn them back. Instead, President Eisenhower's "New Look" strategy relied on massive nuclear retaliation to punish the USSR enough to compel it to stop. This was seen as a credible and effective approach because NATO and Warsaw Pact leaders believed America would directly and immediately suffer unacceptable consequences from the Soviet domination of Europe.²¹

Today, the threat of nuclear retaliation in response to Russia annexing part of a NATO ally or China attacking Taiwan is less credible. These acts of aggression, if successful, would undermine America's security assurances and alliance relationships. They are not, however, likely to affect the American way of life immediately and directly to the degree a successful Soviet invasion of Europe would have over half a century ago. An American nuclear response would

19 OSD, *Military and Security Developments Involving the People's Republic of China 2016*, p. 61.

20 Andrea Macias, "A Detailed Look at How Russia Annexed Crimea," *Business Insider*, March 24, 2015, available at <http://www.businessinsider.com/how-russia-took-crimea-2015-3>.

21 "Dwight D. Eisenhower: Foreign Affairs," Miller Center of Public Affairs, University of Virginia, accessed November 12, 2016 at <http://millercenter.org/president/biography/eisenhower-foreign-affairs>.

likely further damage the international and political systems upon which American prosperity depends. Therefore, adversaries may no longer find U.S. nuclear deterrence to be credible in these situations, making effective conventional deterrence necessary.

Conventional deterrence of adversaries will need to be complemented by the reassurance of allies. In many cases, reassurance places greater demands on U.S. forces and capabilities than deterrence. An adversary may be deterred by the possibility of being denied or punished. In contrast, an ally may expect near surety that U.S. forces will be able to defend its interests. U.S. allies in Asia including Japan, Australia, South Korea, and the Philippines are growing worried about China's maritime build-up and increasingly aggressive behavior at sea. In response, they are modernizing and expanding their navies, particularly their submarine fleets and coast guards, and increasing coordination with U.S. naval forces. Meanwhile, NATO allies and partners in Europe with shrinking, aging, less capable militaries are increasingly worried about Russia's capabilities and behavior. They will likely rely even more on U.S. reassurance.

Given the need and ability of adversaries such as China and Russia to achieve a quick victory at varying levels of escalation and the inappropriateness of nuclear retaliation, the United States should adopt a deterrence approach based upon denying an adversary its objectives and immediately punishing its aggression with proportional, conventional force. This deterrence concept was the basis of U.S. Cold War deterrence after nuclear parity obviated the New Look strategy. Along the Central Front in West Germany, the United States deployed forces astride the Warsaw Pact forces' likely invasion routes. At sea, U.S. naval forces stood by to punish Soviet aggression with strikes against its periphery in Northern Europe and along the Mediterranean.²²

In the future, as in the past, the prospect of being denied in achieving its goals could cause a potential aggressor to refrain from using force. Outright denial may not even be necessary in some cases. A significant delay in achieving its objectives could also deter an adversary from pursuing aggression because America's great power competitors are not well positioned to wage a lengthy conflict. A delay could be complemented by the threat of trans-regional operations to deny an adversary's access to resources and lines of production to further sow doubt about the adversary's ability to achieve its objectives.

The Role of Naval Forces in Deterrence

A return to the "deny-and-punish" approach to deterrence will increase America's reliance on forward-postured forces—particularly naval forces. American aircraft, troops, ships, sensors, and weapons would need to be postured in proximity to a likely area of confrontation so they

²² John Hanley, "Creating The 1980s Maritime Strategy and Implications for Today," *Naval War College Review* 67, no. 2, Spring 2014, available at <https://www.usnwc.edu/getattachment/2b962da8-c60f-4916-9a98-86d1dd831b5b/Creating-the-1980s-Maritime-Strategy-and-Implicati.aspx>; "Surface Warfare and Surface Warriors: An Interview with Joseph Metcalf," *Proceedings*, October 1985, pp. 68–80; and John Hattendorf and Peter Swartz, eds., *U.S. Naval Strategy in the 1980s: Selected Documents*, Newport Paper no. 33 (Newport, RI: Naval War College Press, December 2008).

could rapidly interdict aggression and promptly conduct attacks on targets the enemy values to compel the aggression to stop. Unlike air and ground forces, however, naval units at sea are less subject to host nation restrictions and give the United States the ability to act unilaterally, reducing opportunities for an aggressor to pressure neighboring countries into limiting an American response.

Perhaps counterintuitively, Navy and Marine forces may be a more sustainable way to posture U.S. capabilities forward than ground or air units. Naval forces are less provocative than forces based in a foreign country and may engender less concern by local populations. And unlike ground and air forces, U.S. Navy and Marine forces, although under increased threat from enemy reconnaissance-strike complexes, are mobile, can better defend and sustain themselves in proximity to an adversary, and have the offensive capabilities to deny and punish aggression immediately.

Navies can lend themselves to more proportional, tailored responses since each ship is an independent, self-sustaining unit able to deploy in smaller force packages than ground or air forces that require large-footprint shore-based support and force protection. This enables naval forces to more effectively counter gray zone aggression and manage escalation if a conflict occurs. The ability to respond quickly and proportionally to aggression will increase the likelihood U.S. forces can intercede effectively on behalf of allies and enhance the credibility of U.S. security assurances to them.

Because they are less constrained by host nation concerns, are more survivable, and offer more proportionality, naval forces are likely to be more reassuring to allies facing great power aggression than ground or air forces. In turn, the ability of naval forces to remain postured overseas in the areas needed for effective deterrence relies on periodic access to allied bases and facilities. If Navy and Marine units have ports where they can refuel, conduct repairs, resupply, and change out crewmembers, they can remain deployed for an indefinite period. Reassurance will be essential for allies to be comfortable affording U.S. forces access to their facilities.

Given the value of U.S. naval forces in deterring aggressors and reassuring allies, it is understandable why China, Russia, Iran, and North Korea aspire to field long-range networks to blunt the ability of U.S. naval forces to project power into their respective regions. In crises, U.S. naval forces would certainly be vulnerable in an aggressor's near abroad. In war, they would be challenged to ensure U.S. and allied regional access to resources, battlefields, markets, lines of production, and information while denying the same to adversaries and their proxies. In the space between peace and war, U.S. naval forces would have reason to hesitate when countering gray zone aggression.

Assigning naval forces a primary role in deterrence creates significant implications for fleet architecture that must support a deterrence approach of denial and punishment through a posture tailored to address what potential aggressors want, what they value, and the geographic and alliance conditions in each region. The following chapters will describe this architecture.

CHAPTER 3

Operating Concepts and Warfighting Approaches of the Future Fleet

The return of great power competition suggests dramatic changes to how U.S. naval forces will have to operate by the 2030s. The growing likelihood and potentially catastrophic consequences of great power conflict make deterrence the most important mission for the U.S. military, and the emerging strategic environment will likely increase America's reliance on its naval forces to conduct this mission. As discussed in the previous chapter, naval forces are well suited to reassure allies concerned about threats to their territory and people. They are, likewise, capable of addressing the range of conventional approaches a great power adversary could employ, from gray zone aggression to outright invasion.

U.S. naval forces will, however, need to adopt a new approach to deter aggression by great powers in the emerging strategic environment. The territorial objectives of competitors such as China, Russia, and Iran are close enough for them to potentially achieve a *fait accompli* before U.S. forces could intervene. Additionally, these aggressors' long-range air defense and strike capabilities would further hamper intervention. Simply put, today's approach of threatening to retaliate or reverse an adversary's gains after the fact will not be effective in the future because adversaries will have the ability to achieve their objectives swiftly without resistance and the level of force required to reverse those gains would be considerable. As a result, aggressors might calculate that they could commit aggression without triggering great power conflict.

The United States, and U.S. naval forces in particular, will need to return to their Cold War deterrence concept of denying an aggressor's success or immediately punishing the aggressor to compel it to stop. Compared to the Cold War, however, naval forces in the 2030s will face a more challenging threat environment and more constrained timelines. They will have to adopt new operational approaches to deter under these conditions.

Implications for Missions and Concepts

The overriding importance of deterring great power conflict in the coming two decades and the concomitant shift to a concept based upon denial and punishment will drive changes in U.S. maritime strategy. The current strategy, *A Cooperative Strategy for 21st Century Seapower* (CS21), acknowledges the growing importance of great power competition, but it does not explore the changes to naval posture, capabilities, mission priorities, and fleet design that will be needed to address this competition.²³ Overall, the current strategy remains focused on efficiently sustaining forward presence rather than posturing and preparing forces to deter and respond to great power aggression.

The five functions of U.S. naval forces described in CS21 will continue to be the essential outputs of naval forces. All Domain Access, Sea Control, Power Projection, and Strategic Deterrence contain the capabilities needed to deter major power conflict. The fifth function, Maritime Security, can be provided by naval forces postured to deter aggression, but will likely be a less important driver of fleet design between now and 2030. U.S. allies and partners will increasingly need to assume responsibility for Maritime Security operations such as countering piracy and trafficking or enforcing maritime laws.

How U.S. naval forces provide their functions will, however, need to change significantly to address the improving capability and geographic advantages of America’s potential adversaries. In the permissive environments that U.S. forces faced over the last two decades, a naval function such as Sea Control could be considered broadly as the combination of missions needed to protect naval forces in a maritime area while denying it to adversary forces. The threats to naval forces were modest enough that ships and aircraft could simultaneously conduct sea control missions such as AMD, ASW, and SUW while still conducting offensive operations against enemy forces ashore.

Great powers such as China and Russia are dramatically improving their capabilities to degrade and defeat the U.S. military, and regional powers such as Iran are combining better capabilities with their geographic advantages to challenge American forces more effectively. These trends demand greater focus on each naval mission, which will reduce the ability of naval forces to simultaneously conduct them as broad naval functions. Most importantly, naval forces need new operational concepts that enable them to persist in contested areas long enough to conduct offensive operations to deny and punish adversary aggression.

The operating concepts described below are designed to address the challenges of emerging great power competitors and their ability to contest areas around their territory. The most important missions associated with sea control and power projection are included, and enabling concepts for logistics and sustainment are described in Chapter 5 as part of the discussion of naval posture. Importantly, each of the concepts below assumes a very

.....
²³ Jonathan Greenert, Joseph Dunford, and Paul Zukunft, *A Cooperative Strategy for 21st Century Seapower* (Washington, DC: Department of the Navy, 2015).

contested communications environment that will demand an increased reliance on individual commanders leading operations without higher headquarters guidance.

The concepts below also rely to a great degree on line-of-sight and LPI/LPD communications, which constrains the ability of the force to command and control manned and unmanned forces over a wide area. Thus, manned platforms are often used in the below concepts to manage a group of unmanned vehicles and systems. If communications capabilities are improved or the communications threat reduced, a smaller number of manned platforms could manage and control a larger number of unmanned systems. This would reduce the overall number of manned platforms needed in the future fleet, but would incur risk.

These concepts also assume increased autonomy of unmanned systems in 2030. Because of limitations on sensor capability, communications, and policies, they do not assume unmanned systems can completely replace manned platforms for most missions. Some operations, such as surveillance or mining, are assumed to be executable by unmanned systems, but more complex missions such as finding, classifying, and engaging enemy targets without operator intervention are assumed to be unachievable in 2030.

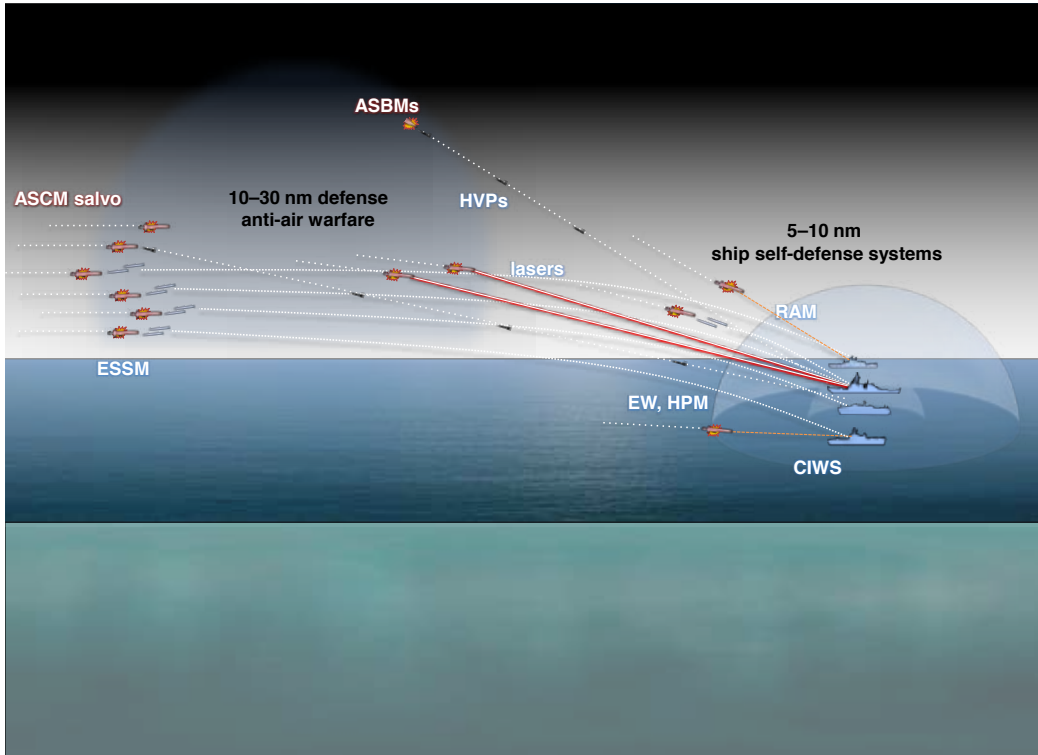
Air and Missile Defense

Competitors such as China, Russia, and Iran are fielding large numbers of long-range air- and ground-launched ASCMs as part of their efforts to contest the seas around their territory and the potential objects of their aggression. Today's U.S. naval forces face significant air defense capacity shortfalls in these situations because they are the "away team" and must bring all their offensive and defensive weapons with them, whereas the aggressor is the "home team" and able to base its anti-ship capabilities ashore. The growing size and sophistication of air and missile threats require an increasing portion of a ship's magazine capacity to be devoted to defensive weapons, subsequently reducing the capacity of today's naval forces for strikes or anti-ship attacks as part of a strategy to deny or punish enemy aggression.

As described in previous CSBA studies, U.S. naval forces need to adopt a new AMD concept that provides them enough defensive capacity to survive in contested areas while increasing the amount of magazine space for offensive weapons.²⁴ This concept would use long-range layered air defenses against enemy aircraft and conduct missile defense operations at medium (10–30 nm) and short (less than 10 nm) ranges. Figure 4 displays this new approach.

24 Bryan Clark, *Commanding the Seas: A Plan to Reinvalidate U.S. Navy Surface Warfare* (Washington, DC: Center for Strategic and Budgetary Assessments, 2014); and Mark Gunzinger and Bryan Clark, *Winning the Salvo Competition: Rebalancing U.S. Air and Missile Defenses* (Washington, DC: Center for Strategic and Budgetary Assessments, 2016).

FIGURE 4: NEW AIR AND MISSILE DEFENSE CONCEPT



This shift would enable greater use of smaller medium-range defensive interceptors such as the Evolved Sea Sparrow Missile (ESSM), four of which can be carried in the same vertical launch system (VLS) cell that carries a single longer-range SM-2 or SM-6 interceptor. The new AMD concept also envisions using new kinetic defenses to reduce the demand on traditional interceptors. For example, today's naval artillery could engage missile threats at 5–20 nm using new guided projectiles such as the DoD Strategic Capabilities Office's Hypervelocity Projectile (HVP) or the Defense Advanced Research Projects Agency's (DARPA) MAD-FIRES.²⁵ Although less accurate than interceptors, three to five of these projectiles could be shot at each incoming missile to ensure it is destroyed for a total cost that is still less than the missile being shot down.

Medium-range missile defense would also utilize high-capacity, non-kinetic capabilities such as lasers, electronic warfare (EW) systems, and high-power radiofrequency (HPRF) weapons to further reduce the demand on interceptors. These line-of-sight defenses would have a maximum range of about 10 nm against low-altitude sea-skimming missiles, although their

.....
 25 According to BAE Systems, a HVP's surface-to-surface firing range is more than 40 nautical miles when fired from a Mk 45 Mod 2 5-inch gun and more than 70 nautical miles when fired from a 155mm gun on a DDG-1000 class destroyer. See BAE Systems, "Hyper Velocity Projectile (HVP)," factsheet, updated June 2016, available at <http://www.baesystems.com/en/product/hyper-velocity-projectile-hvp>.

effective ranges against missiles and aircraft at higher altitudes would be longer. Today EW systems are only used as a last resort when interceptors have failed. By moving to a medium-range AMD concept, they could be used in place of interceptors.²⁶ By reducing the reliance on interceptors for air defense, more VLS magazine space can be devoted to the offensive weapons needed to support a deny-and-punish approach to deterrence. Longer-range interceptors such as SM-2 and SM-6 could be used as offensive weapons to engage enemy aircraft or ships before they can launch ASCMs.

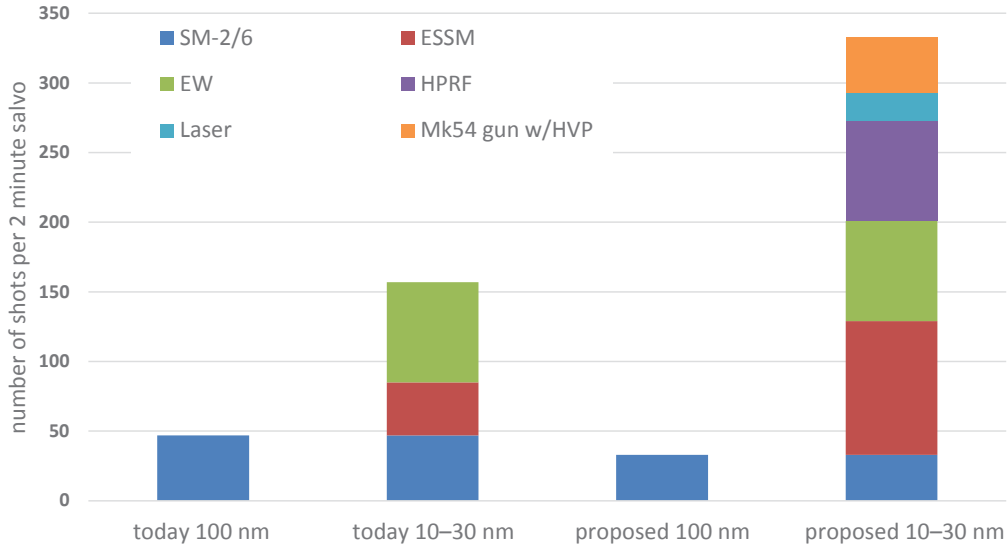
Battle management is essential to increasing defensive capacity and reducing the fleet's dependence on kinetic interceptors. The reason today's approach falls short in AMD capacity is that the largest and most expensive long-range interceptors are used against every incoming air threat, followed by shorter-range interceptors and self-defense systems until the threat is defeated. Taking advantage of smaller interceptors and non-kinetic defenses that operate at medium ranges will require quickly matching incoming air threats to the appropriate defensive system.

The impact on air defense capacity of the new air defense concept and associated capabilities is depicted in Figure 5 for a single Flight IIA DDG-51 engaging a salvo of ASCMs over a period of 2 minutes.²⁷ The new air defense approach exchanges some long-range SM-2 and SM-6 interceptors able to reach air threats for medium-range ESSMs. It also adds lasers, HVPs, and HPRF weapons to the ship for air defense. As the figure shows, the new systems provide much more defensive capacity than the current approach while reserving the same percentage of the ship's VLS magazine for offensive weapons. Alternatively, this approach could also be used to increase surface combatants' offensive firepower while still providing somewhat more defensive capacity than that of today's fleet.

26 A laser defeats an incoming ASCM by heat damage to the missile seeker or to the outer shell of the ASCM, causing it to lose control. This will take several seconds; depending on the power of the laser and the type of missile, a laser may not be effective. For example, a ballistic missile warhead is hardened against the heat of atmospheric entry and would be difficult to damage with a laser. The HPRF damages an ASCM by creating voltage and current spikes in the missile's electronics that damage its guidance or other systems. EW systems defeat an ASCM by causing a radar-seeking missile to lose lock on the ship, then deceiving it into missing the ship or attacking a false radar target such as the Navy's Nulka decoy. Each of these systems is limited by the horizon. With an antenna at 100 ft in height, the horizon is about 10 nm away.

27 For air defense, a DDG-51 has a 96-cell VLS magazine and a SLQ-32 EW system.

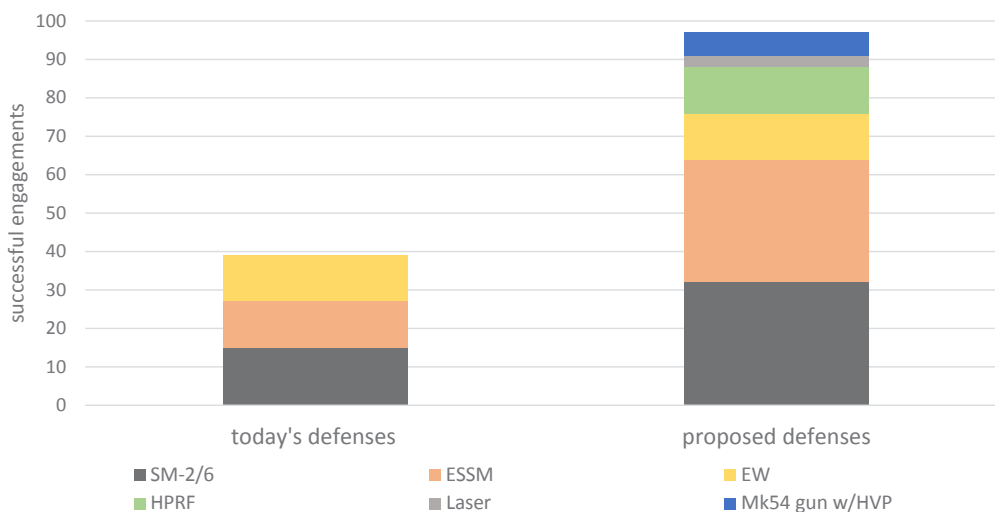
FIGURE 5: DEFENSIVE CAPACITY OF A DDG USING NEW AMD CONCEPT



Weapon	Notional current VLS allocation	Proposed VLS allocation
SM-3	10%	10%
SM-6	20%	20%
SM-2	30%	15%
ESSM	10%	25%
Tomahawk	25%	25%
VLA	5%	5%
1 Mk-45 gun with HVP	0	20 rounds per minute
1 400kW laser	0	6 seconds per missile defeat

Figure 5 shows the number of shots possible with current and proposed future air defense systems, but often more than one shot will be required to destroy or defeat an incoming air threat. Systems with a higher single shot probability of kill (Pk) values will require fewer shots to destroy an incoming missile. For example, a system with a Pk of 0.7 against a particular air or missile threat requires three shots to defeat it, whereas a system with a Pk of 0.4 would need six shots to achieve a kill. Figure 6 shows the number of successful engagements possible with the current and proposed air defense schemes taking realistic Pk values into account.

An additional benefit of the new air defense approach is it increases the Navy’s reliance on systems that do not need to be reloaded after each salvo. Naval guns automatically reload after each shot, whereas EW systems, HPRF weapons, and lasers only need continuous power to engage the next salvo. In contrast, interceptors such as SM-2 or ESSM would be completely expended against a large salvo, such as those shown in Figure 5. Currently U.S. surface combatants cannot reload their VLS magazines at sea, requiring that they pull in to a friendly port to do so. Even so, reloading at sea, which is technically possible, would require taking the ship offline for hours.

FIGURE 6: SUCCESSFUL ENGAGEMENTS FOR NEW DEFENSIVE SYSTEMS²⁸

Efforts to increase the defensive capacity of naval forces should be complemented with new concepts for electromagnetic spectrum warfare and distributed operations that could dilute enemy salvos to levels that could be handled better by ships' defensive capacities, thus enabling naval forces to persist in contested areas. These concepts are discussed in the sections that follow.

Electromagnetic Spectrum Warfare

To support the deterrence concept of denial and punishment, American naval forces will need to operate and fight in proximity to an adversary. As described above, U.S. surface forces will face large numbers of enemy anti-ship missiles in these areas and thus require high-capacity air defenses to survive long enough to conduct their offensive missions. Active defenses may, however, be insufficient to win the "salvo competition" between the enemy's weapons systems and U.S. defenses. To reduce enemy salvos to more manageable levels, U.S. naval forces will also need to deny or degrade the enemy's ability to find and target ships.

As described in a previous CSBA report, EMS warfare moved through a series of phases during the last century.²⁹ The current phase started in the late Cold War when U.S. forces found that increasingly unsustainable levels of jamming and suppression attacks were needed to overcome improving Soviet air defense systems. This led DoD to shift from overtly countering enemy air defenses to hiding from them using stealth and LPI/LPD communications

²⁸ Chart assumes the Pk of ESSM and SM-2/6 is 0.7; it assumes the Pk of EW, HPRF, laser, and Mk54 with HVP weapons is 0.4.

²⁹ Bryan Clark and Mark Gunzinger, *Winning the Airwaves: Regaining America's Advantage in the Electromagnetic Spectrum* (Washington, DC: Center for Strategic and Budgetary Assessments, 2015).

and sensors.³⁰ The end of the Cold War interrupted this shift, but, with the resurgence of great power competition, U.S. forces will need to continue their move to a “low-to-no power” concept of EMS warfare, which the Navy describes as “Electromagnetic Maneuver Warfare.”

Preventing successful enemy detection and targeting—or counter-ISR—will require coordinated jamming, decoy, communications, and sensing operations in the EMS, similar to those depicted in Figure 7. The objective of these operations would be to degrade the quality of sensor data from actual targets while creating numerous viable false targets. As a result, the enemy will have to attack more potential targets to ensure actual ones are engaged, diluting enemy weapons salvos and reducing the number of weapons that actual naval forces need to engage, falling within the capacity of ship defensive systems.

FIGURE 7: EMS WARFARE TO COUNTER ADVERSARY ISR



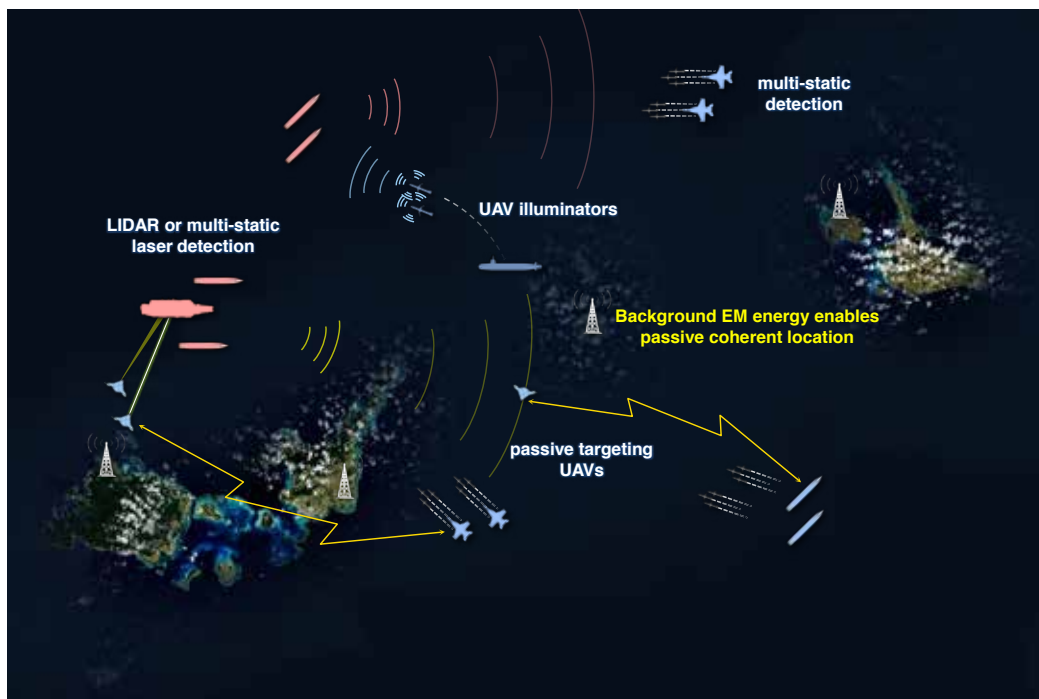
U.S. naval forces will need to use low-power stand-in jammers to degrade radars and low-power active and passive decoys to confuse adversary sensors. These systems will need to be networked so they can coordinate their operations to create a coherent, but false, picture to the enemy. They will also need to be deconflicted in real time with friendly communications and sensors. As described in the previous section on air and missile defense, ships would

³⁰ LPI transmissions are difficult to intercept because they operate at low power, have highly adjustable power levels, have very narrow beams, or are highly directional. LPD transmissions are difficult to detect as sensor or communications signals because they use unexpected waveforms, are disguised as other EM transmissions, are hidden in EM transmissions, or have characteristics that make them difficult to classify.

still employ self-protection jamming from systems such as the Surface Electronic Warfare Improvement Program (SEWIP), which would be complemented by decoys such as the Nulka system and offboard EW UAV.

Because jammers and decoys emit in the EMS, they could create a risk of counter-detection. To reduce this possibility, these systems will need to be networked and coordinated with the broader EMS warfare effort to ensure they do not give away the location of U.S. forces or interfere with friendly EMS operations. As Figure 7 shows, new elements of the fleet architecture will be needed to support these EMS operations, such as XLUSVs and XLUUVs that deploy jammers or decoys or that launch smaller UAVs, unmanned surface vehicles (USV), or UUVs to conduct counter-ISR operations. To defeat enemy sensors without inadvertently revealing the location of U.S. forces through reflected radiofrequency (RF) energy, jammers and decoys will need to operate at low power, making unmanned vehicles that can more closely approach adversary sensors more appropriate for these systems.

FIGURE 8: EMS WARFARE LOW-TO-NO POWER SENSING OPERATIONS



Passive sensing by U.S. naval forces is an essential component of offensive operations in this low-to-no power approach to EMS warfare. Because potential U.S. adversaries such as China, Russia, or Iran would be operating on or near their home territory in a conflict, they could employ numerous passive sensors in their region, which would exploit the adversary's knowledge of the local environment and ability to network sensors using fiber optic cables rather than RF networks. Passive sensors would enable adversaries to detect readily identified

emissions associated with U.S. naval forces, such as those of the Aegis SPY-1 radars or ultra-high frequency (UHF) satellite communications, at long ranges.

To find and engage enemy targets while reducing their own risk of counter-detection, U.S. forces could use the techniques shown in Figure 8, such as passive sensors to detect enemy emissions and passive radar to detect EM energy from emitters of opportunity reflected off targets. Multistatic radar can also passively receive the reflections from targets illuminated by friendly radars on distant manned platforms or nearby unmanned vehicles. These operational concepts will also require specialized elements of fleet architecture to implement.

Passive and LPI/LPD sensing capabilities will need to be closer to the target than the high-power active RF sensors of today. Unmanned vehicles would provide a way to conduct these targeting operations while reducing risk of counter-detection because they are smaller. Unmanned vehicles can also support the LPI/LPD and passive sensing operations of manned platforms by, for example, acting as the emitter for multistatic sensing conducted by a manned aircraft or networking sensors with manned platforms to create a “virtual array” that can detect contacts using acoustic energy undersea or RF energy above the water. Because it is larger, a virtual array can potentially detect targets at much longer ranges than a single, smaller array on a single platform.

Anti-Submarine Warfare

Submarines have been used to contest sea lanes and coastal waters since they were first employed a century ago. They are an increasingly popular element of adversary reconnaissance-strike networks because they are challenging to find, especially in an environment where anti-ship and anti-air weapons can threaten U.S. ASW platforms. Executing a deterrence strategy of denial and punishment will require an effective approach to defeat enemy submarines in contested areas; China is deploying many relatively noisy diesel and nuclear submarines, and Russia is fielding a small number of very quiet, highly capable nuclear submarines.

As described in prior CSBA reports, previous ASW campaigns were most effective when they exploited the three significant limitations of submarines:³¹

- They are slower than the ships and aircraft that they target or that are hunting them, particularly when the submarine is trying to remain quiet;
- They have little or no self-defense capabilities, particularly compared to surface ships; and
- Their sensors are relatively short range and lack the accuracy or precision of radar and other RF-based sensors.

31 Bryan Clark, *The Emerging Era in Undersea Warfare* (Washington, DC: Center for Strategic and Budgetary Assessments, 2015); and John Stillion and Bryan Clark, *What it Takes to Win: Succeeding in 21st Century Battle Network Competitions* (Washington, DC: Center for Strategic and Budgetary Assessments, 2015).

These limitations enabled previous ASW efforts to marginalize or render ineffective submarines by harassing, threatening, or attacking them—even if very few submarines were sunk in the process. In World War II, for example, the number of German submarines destroyed each month rarely exceeded twenty, and the number deployed in the Atlantic remained over forty from mid-1941 until 1945. In 1943, however, Allied shipping losses dropped by 90 percent and remained below 50,000 tons a month for the rest of the war.³²

ASW campaigns over the last century can also be characterized in terms of the predominant ASW sensor technology of the time. From World War I through the end of World War II, this was radar and radio intercepts in the EMS, because submarines spent most of their time on the surface to recharge their batteries and air supply. Nuclear submarines changed this dynamic at the start of the Cold War because they could remain submerged indefinitely. They did, however, generate continuous noise from their pumps and other machinery. This made them susceptible to passive sonar to a degree diesel submarines were not.

Nuclear submarines were the most concerning undersea threat through the Cold War since they could keep up with and threaten enemy surface fleets or deploy overseas to attack the enemy's homeland. As a result, throughout the Cold War, offensive ASW operations to find and engage submarines shifted to using passive sonar. In particular, the United States deployed Sound Surveillance System (SOSUS) arrays off the U.S. coast and near the choke-points Soviet submarines had to transit to reach open ocean. To counter passive sonars, the U.S. Navy, and later the Soviet Navy, developed succeeding generations of quieter nuclear submarines.

Concerned about the ability of quieter Soviet attack submarines to evade passive sonar detection, the U.S. Navy began developing low frequency active (LFA) sonar in the 1980s for offensive ASW, which circumvents efforts at submarine quieting and can find submerged targets at longer ranges and over a wider area than passive sonar or previous generations of higher frequency sonars.³³ The Cold War ended, however, before the United States had to rely on this new ASW technology.³⁴

Today, the latest class of Russian submarines is as quiet as U.S. submarines, and the previous generation of Russian submarines is on par with older U.S. boats that are still in service.³⁵ Chinese submarines, although relatively noisy, are more numerous and will be challenging to track and engage.³⁶ Both countries' submarines can attack U.S. ships with ASCMs before they are within passive sonar range. To counter these improving threats, the future fleet will need to return to some of its Cold War approaches for offensive ASW, as illustrated in Figure 9.

32 Ibid.

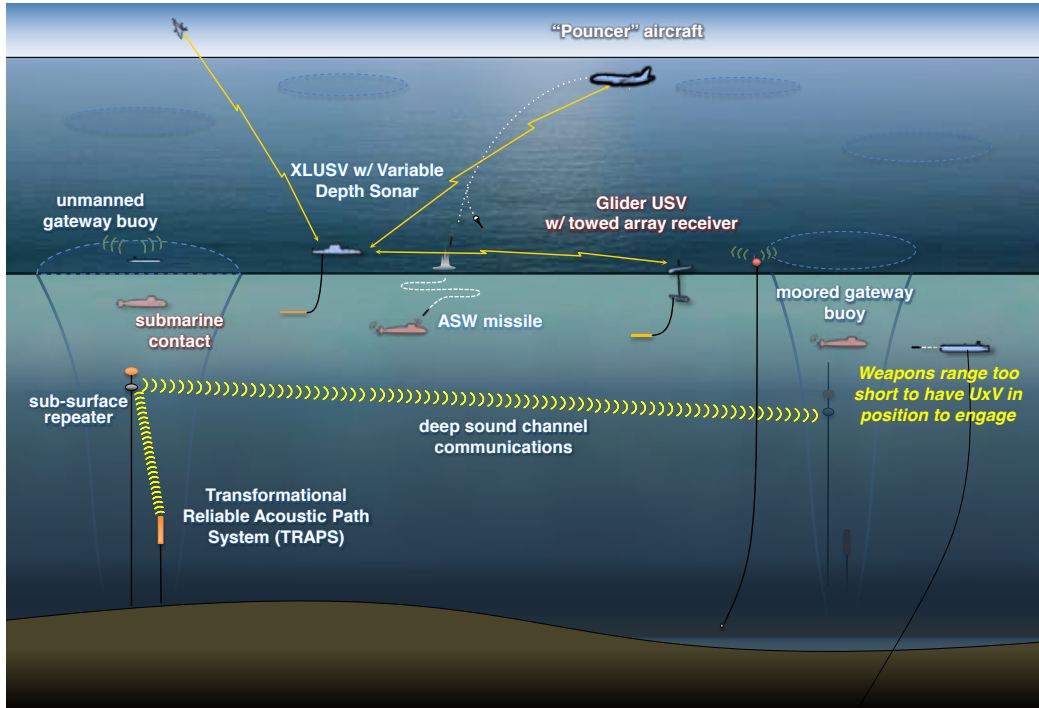
33 LFA suffers less attenuation than higher frequency active sonars, which enables it to detect contacts at longer ranges.

34 Stillion and Clark, *What it Takes to Win*, p. 39.

35 Hicks, Metrick, and Samp, *Undersea Warfare in Northern Europe*.

36 ONI, *The PLA Navy*.

FIGURE 9: NEW OFFENSIVE ASW CONCEPTS



Whereas the initial LFA sonars were only useful to cue other sensors, faster computer processing has improved accuracy and precision over the last 30 years. Today, this technology is used in the U.S. Navy's Integrated Undersea Surveillance System (IUSS) ships, and smaller versions are used in the variable depth sonars (VDS) employed by many foreign navies and the American LCS ASW mission package. LFA sonar deployed by XLUSVs could be the sound source for multistatic sonar operations, and glider UUVs with passive towed arrays could receive sonar reflections off enemy submarines from various aspects. These techniques could support engagements by "pouncer" manned and unmanned aircraft or standoff ASW missiles to reduce the time manned platforms need to be in the contested areas.

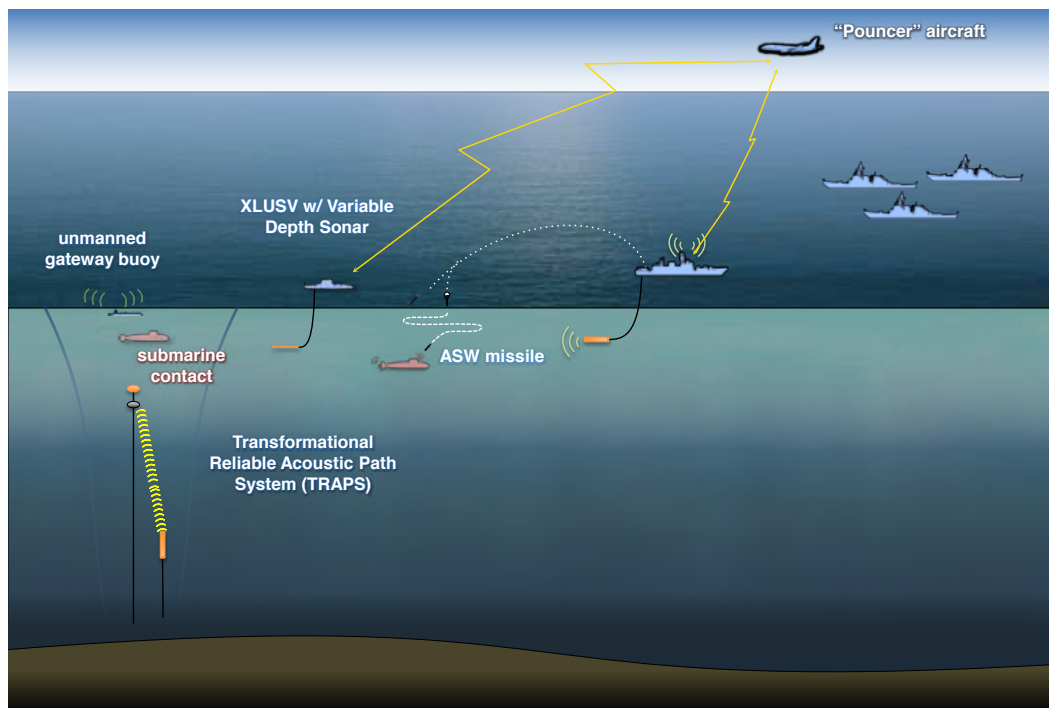
Passive sonar can also be employed for offensive ASW, but in ways that do not put manned platforms at risk. Instead, unmanned passive sonar arrays such as the new TRAPS arrays can be employed. The TRAPS system consists of a bottom-mounted vertical sonar array that detects sound in the water column above. Target information is passed to a buoy near the surface using acoustic communications, which relays target information to other forces using RF communications.³⁷ As with the LFA sonars, submarines detected with unmanned passive sonar arrays like TRAPS would be prosecuted by pouncer aircraft or with standoff ASW missiles.

37 DARPA, "Distributed Agile Submarine Hunting (DASH) Program Completes Milestones," DARPA news release, April 3, 2013, available at <http://www.darpa.mil/news-events/2013-04-03>.

New approaches will also be needed to conduct defensive ASW against submarines that are able to approach U.S. surface ships. The most significant threat posed by submarines is their ability to launch ASCMs before they get close enough either to be detected by shipboard high-frequency active sonars and towed passive sonars or to be engaged by current shipboard- or helicopter-launched torpedoes. To enable detection at longer ranges, surface combatants could use VDS systems to spot submarines nearing their ASCM range and use standoff missiles or helicopter- and UAV-launched torpedoes to engage them, as shown in Figure 10.

In contrast to offensive ASW operations where a high Pk torpedo would be needed to complete the mission, defensive ASW would benefit from small, inexpensive weapons that can be carried in large numbers by pouncer platforms—even if they have a low Pk. Even low Pk weapons will be effective in a defensive application because they exploit the submarine’s major disadvantages. The enemy submarine will likely have to evade immediately because it cannot defeat the incoming torpedo, is relatively slow compared to the torpedo, and lacks the ability to rapidly determine the torpedo’s likely trajectory and probability of success. This takes the submarine away from its mission and reduces its stealth, resulting in an, albeit temporary, mission kill.

FIGURE 10: NEW DEFENSIVE ASW CONCEPTS



Some concepts useful in offensive ASW could also be employed for defensive ASW. For example, TRAPS arrays could be used in advance of CSGs or as barriers around operating areas to detect approaching submarines. XLUSVs with LFA arrays could detect enemy submarines at standoff range from nearby friendly naval forces, which could engage with pouncer

aircraft or UAVs. In addition to their longer detection range, LFA sonars are an overt sensor and could deter enemy submarines from approaching U.S. forces.

Undersea Warfare

In the Cold War, U.S. submarines tracked and stood by to engage Soviet attack submarines. They also operated in the protected bastions near the Soviet Union to threaten Soviet ballistic missile submarines as an element of strategic deterrence. In turn, Soviet attack submarines attempted to evade U.S. surveillance efforts and threaten U.S. carrier battle groups.

The introduction of submarine-launched cruise missiles in the middle of the Cold War changed how undersea forces were used. In the two World Wars, submarines lacked the speed to chase down ships and had to position themselves in transit lanes so they could attack using the short-range torpedoes of the time. Cruise missiles gave them the ability to attack ships hundreds of miles away and conduct land strikes a thousand miles inland. This expanded a submarine's range of action and reduced the impact of its limited speed on its warfighting effectiveness.

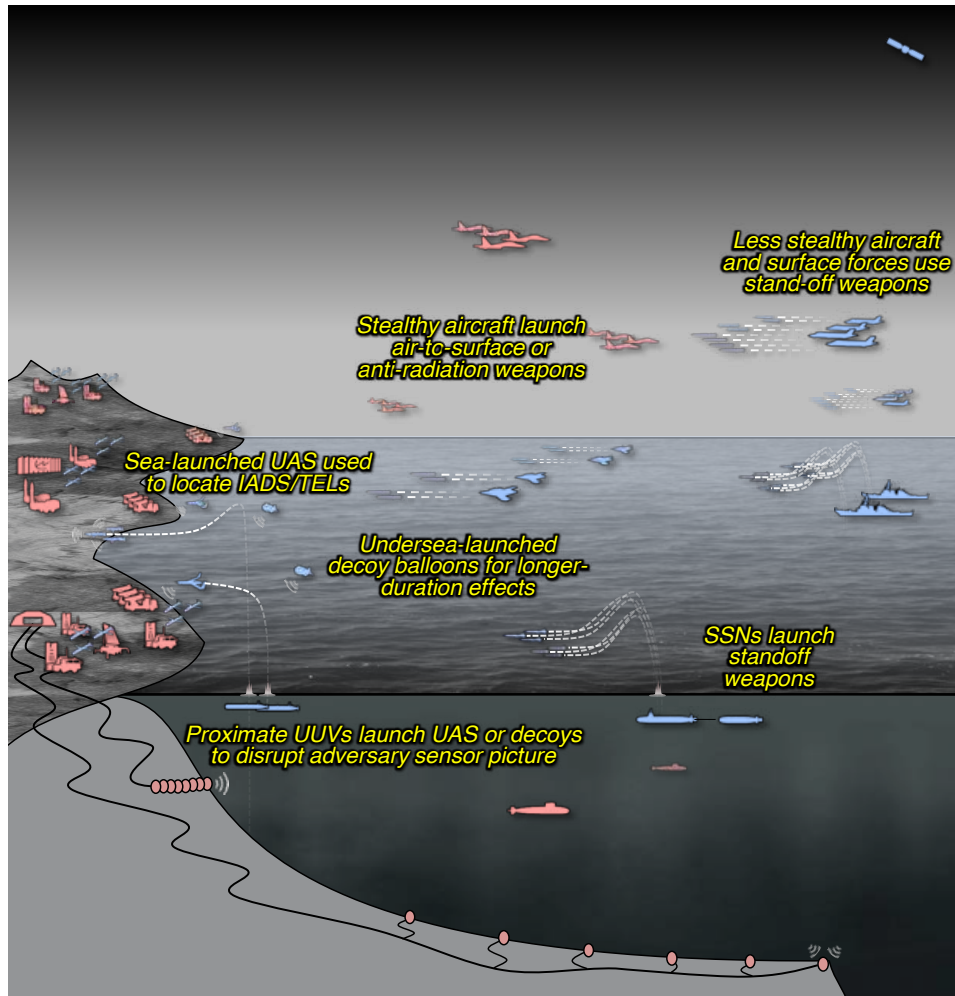
The advent of UUVs is further expanding the reach and capacity of submarines, giving them the opportunity to deploy additional sensors or long-range autonomous weapons. Further, large UUVs such as XLUUVs could have the endurance, redundant systems, and sensor capacity to operate independently of submarines and ships. Autonomy is a function of all these elements, because regardless of the sophistication of a UUV's control systems, it still must be able to accurately sense its surroundings, work through material failures, and operate for a long enough period to be truly independent of manned host platforms. By the 2030s, UUV autonomy will be sufficient for missions such as minelaying, surveillance, or carrying weapons payloads in which they can conduct preplanned operations while adapting and reacting to conditions they find such as shipping traffic, weather, or enemy defenses. UUVs can conduct these operations in concert with manned platforms, as described for ASW, in which the UUV provides additional sensors, weapons capacity, or countermeasures.³⁸

The great power competitors America faces recognize the threat posed by U.S. submarines. With technology proliferation, they are likely to pursue some of the aforementioned ASW approaches, particularly in their own coastal areas.³⁹ The increased risk to U.S. submarines and the growing capability of UUVs will lead to new concepts for undersea operations. Instead of submarines directly conducting strike, surface warfare, or ASW missions close to enemy shores, they will increasingly be used as platforms for command and control (C2) of UUVs, unmanned sensors, and standoff weapons that conduct these operations.

38 For more details on the Navy's assessment of AUVs and UUVs, see CNO, Undersea Warfare Directorate, *Report to Congress: Autonomous Undersea Vehicle Operations in 2025* (Washington, DC: Department of the Navy, 2016), pp. 4–7.

39 Lyle Goldstein and Shannon Knight, "Wired for Sound in the Near Seas," *Proceedings*, April 2014, available at <http://www.usni.org/magazines/proceedings/2014-04/wired-sound-near-seas>.

FIGURE 11: FUTURE UNDERSEA OPERATIONS



This shift from employing submarines as tactical platforms to operational-level platforms is similar to the shift in the mid-20th Century from battleships and cruisers directly attacking shore targets with guns to aircraft carriers and amphibious assault ships using aircraft, troops, and later missiles to do so. Figure 11 depicts new ways offensive undersea operations could be conducted by the future fleet. For example:

- Mining using large UUVs that deploy small UUV smart mines that can move into position or to engage a target;
- EW against enemy air defense systems using large UUVs that launch small UAVs which jam and decoy enemy radars;
- Attacks against fixed targets ashore with cruise missiles launched from large UUVs; and

- Attacks against ships or relocatable targets from submarine-launched cruise missiles or long-range torpedoes that receive targeting updates from UUV-launched UAVs.

Surface and Strike Warfare

In combination, the concepts above for AMD, EMS Warfare, ASW, and undersea warfare will enable U.S. undersea, air, and surface naval forces to operate in contested areas long enough to engage adversary targets promptly after hostilities break out, slowing or perhaps preventing the enemy's success. They also will enable U.S. naval forces to attack valuable enemy targets to punish aggression. Figure 12 displays this approach, which relies on unmanned vehicles for passive, multistatic, and LPI/LPD sensing and targeting, as well as standoff weapons to achieve mission kills against surface combatants and submarines. A surface combatant struck with even a small ASCM will have to retire for days or weeks for repairs; as discussed above, once attacked, a submarine will need hours or days to recover its stealth, taking it out of the fight for at least that period.

The Navy's current concept for this operational approach is Distributed Lethality (DL), which relies on individual or small groups of platforms distributed over a wide area such as the South China Sea or Eastern Mediterranean.⁴⁰ These forces are not simply large formations such as CSGs that are dispersed; they are self-sustaining groups that are able to independently defend themselves and conduct offensive operations. Each ship, therefore, needs to have defensive and offensive capabilities.

This construct increases the number of individual targets the enemy would have to attack. If the individual ships are using a high capacity air defense concept and electromagnetic maneuver warfare, the number of enemy weapons required for successful engagements increases further. The need for multiple large salvos could dissuade the adversary from attacking the distributed force in detail, because it wants to reserve weapons for other attacks later in the conflict.

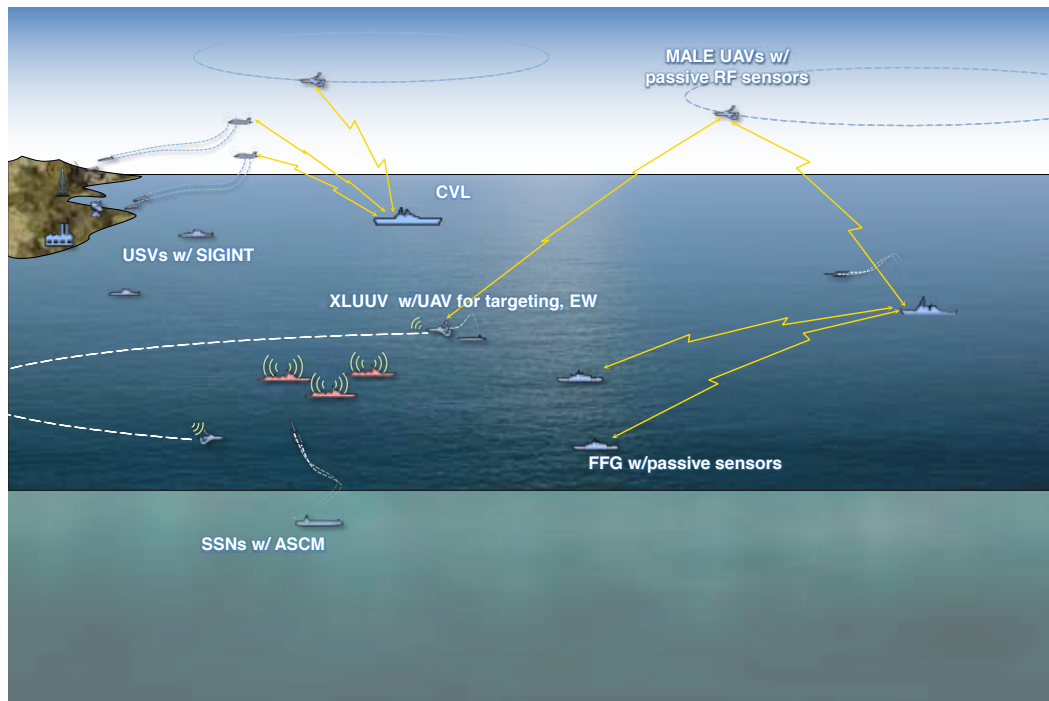
A key factor affecting the success of SUW and strike operations is the ability of naval forces to engage enemy surface combatants based on fleeting targeting information.⁴¹ Adversaries can be expected to pursue some of the same concepts for EMS operations described above, which will reduce the ability of naval forces to consistently find and target them. Distributed operations and long-range anti-ship and strike weapons such as Tomahawks and the Long-Range Anti-Ship Missiles (LRASM) will help ensure that a weapons platform can be in position to quickly engage a target before it is lost again. Naval aviation can also help address fleeting

40 Thomas Rowden, Peter Gumataotao, and Peter Fanta, "Distributed Lethality," *Proceedings*, January 2015, available at <http://www.usni.org/magazines/proceedings/2015-01/distributed-lethality>.

41 Within naval circles, there is concern of being "out-sticked" by adversary surface-to-surface missiles. While this range differential is important, it is not the most pressing operational consideration. Being able to act immediately on high quality (but fleeting) targeting information is the primary driver for additional range requirements for U.S. surface-to-surface missiles.

targets by rapidly getting into position for an attack. Strike-fighters flying from aircraft carriers or LHA/LHDs would be able to promptly attack enemy ships and shore facilities to counter aggression or begin imposing costs.

FIGURE 12: COORDINATED ANTI-SURFACE AND ANTI-SUBMARINE OPERATIONS



Mine Warfare

Renewed threats from Iran in 2011 to mine the Strait of Hormuz raised the importance of mine countermeasures (MCM) for the Navy after two decades of inattention following the Iran–Iraq War and Operation Desert Storm.⁴² These efforts, however, were hindered by the small and aging MCM capacity of the U.S. fleet. The Navy’s eleven MCM ships are more than 20 years old, are slow at sweeping and neutralizing mines, and need to enter the minefield to clear it. In the coming decade, the Navy plans to replace MCMs with LCSs carrying an MCM mission package (MP) of UUVs, USVs, UAVs, and helicopters to clear mines.⁴³

42 Daniel Sagalyn, “Iranian Navy Watching as U.S. Launches Exercise in Strait of Hormuz,” *PBS NewsHour*, September 16, 2012, available at <http://www.pbs.org/newshour/rundown/navy-exercise/>.

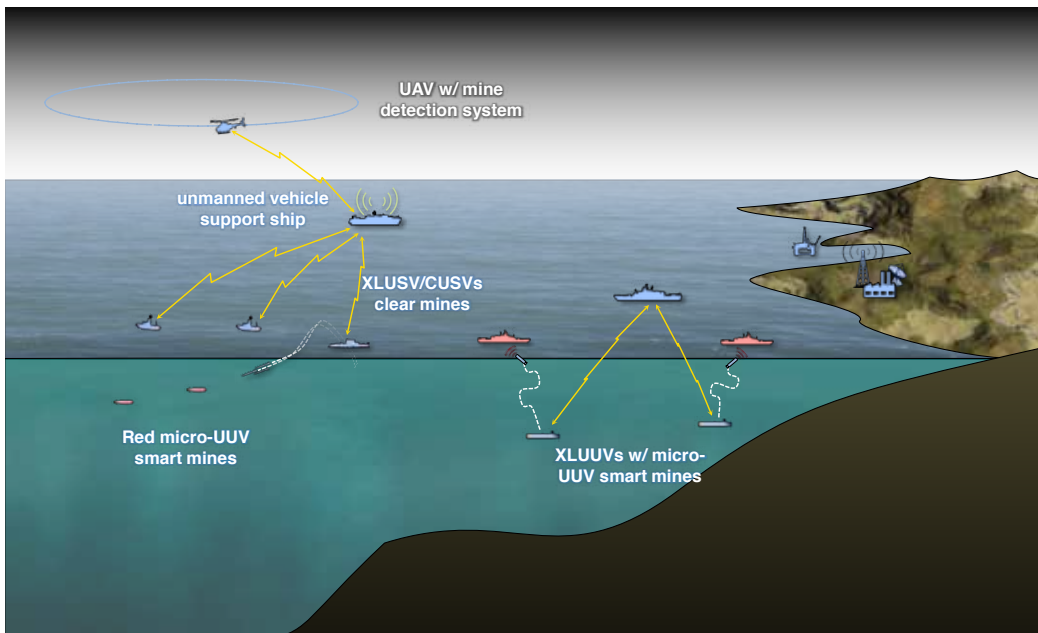
43 U.S. Navy, “Fact File: Littoral Combat Ship Mine Countermeasures Mission Package,” updated September 6, 2016, available at http://www.navy.mil/navydata/fact_display.asp?cid=2100&tid=425&ct=2.

In the emerging era of great power competition, mine warfare will return to prominence.⁴⁴ Mines are an effective and inexpensive way for potential aggressors to attack their neighbors and slow or stop U.S. and allied intervention. Conversely, U.S. naval forces can use mines to deny or delay enemy aggression or punish the aggressor by, for example, shutting down their commercial and military ports.

The MCM MP represents a shift in mine warfare operations toward unmanned systems. In this new approach, USVs and UUVs carry sonars to search for mine-like objects in the water column or on the sea floor, or they tow sweep gear to remove or detonate mines. Unmanned or remotely operated mine neutralization vehicles can then be used to destroy mines in place. Using unmanned systems keeps people out of the minefield and enables mine clearance operations to be scaled up more easily than today's ship-centric approach using single-mission minesweepers. This trend will likely continue, if not accelerate by 2030, making mine clearing almost entirely reliant on robotic and unmanned systems.

Unmanned vehicles will also be the preferred means of mine laying. Placing mines in predetermined locations is a straightforward mission that requires minimal autonomy. Further, to be most effective, mines should be laid in chokepoints, ports, or littoral areas close to enemy ports. These factors make UUVs, in particular, the best means of placing mines. Figure 13 shows these new approaches for offensive and defensive mine warfare.

FIGURE 13: MINE LAYING AND CLEARING OPERATIONS



44 Scott Truver, "Taking Mines Seriously," *Naval War College Review* 65, no. 2, Spring 2012, available at <https://www.usnwc.edu/getattachment/19669a3b-6795-406c-8924-106d7a5adb93/Taking-Mines-Seriously--Mine-Warfare-in-China-s-Ne>.

The shift to unmanned systems suggests the Navy's fleet architecture should use unmanned vehicle support vessels for mine warfare, rather than purpose-built MCMs or small combatants such as LCS. A ship designed to carry, host, and resupply UAVs, USVs, and UUVs will provide greater capacity for mine operations than an MCM or LCS. It could also enable greater flexibility, since its unmanned vehicles could support several different missions such as ISR, ASW, or EMS Warfare when they are not conducting mine warfare operations.

Amphibious Operations

As described above, naval surface and air forces will be challenged to survive in contested environments long enough to deny and punish great power aggression. Amphibious forces ashore, however, may be more survivable than those at sea or in the air, because they can hide in terrain, require more detailed attacks to be defeated, and can leverage internal lines of communication. America's competitors have exploited these advantages for decades against U.S. precision strike capabilities; amphibious operations could enable U.S. forces to do the same. Amphibious raids may also be necessary to find and defeat an enemy's ground-based weapons and sensors on islands or coastlines.

The key challenge faced by U.S. amphibious operations will be the increasing range of adversary coastal defenses. U.S. naval forces will require new operating concepts and capabilities that can circumvent or defeat sophisticated anti-ship and anti-air weapons and enable the kinds of amphibious operations needed to deny or punish aggression. These two imperatives are interrelated. To dilute enemy salvos and lower the number of weapons arriving at a target to be within the capacity of its defenses, an amphibious force will need to disperse, become less detectable, and reduce its time in contested areas. At the same time, new precision weapon, sensor, and countermeasure technologies will allow smaller, lighter, and more distributed amphibious forces to achieve similar effects in shorter periods of time than those that fought in previous conflicts.

The emerging missions for amphibious forces also lend themselves to more distributed approaches. For example, long-range land-based weapons such as China's missile batteries on islands in the South China Sea, Iran's coastal defense ASCMs along the Strait of Hormuz, or Russia's long-range SAMs on the Baltic Sea can contest the ability of U.S. forces to deny or punish aggression. In past conflicts, coastal defenses were large and fixed, making them vulnerable to air attack. Today's potential adversaries are increasingly turning to small mobile missile batteries and sensors to improve their survivability. Small, distributed amphibious raids may be needed to find these systems so they can be destroyed by air strikes or with explosive charges.

The need for more distributed and agile amphibious operations has significant implications for the operating concepts, force structure, capabilities, sustainment, and posture of amphibious forces. The U.S. Marine Corps recognized the importance of new warfighting approaches in its recent publication of an updated Marine Corps Operating Concept (MOC). The MOC

emphasizes the use of advance bases, a wider range of maritime platforms, cross-domain fires, distributable units, and lighter, more agile forces.⁴⁵ The MOC is complemented by the Navy's new Littoral Operations in Contested Environment (LOCE) concept.⁴⁶

A deterrence concept of denial and punishment will require amphibious forces to be postured inside contested areas to interdict aggression; it will also require that they can safely conduct amphibious operations at longer ranges and over wider areas. The Navy and Marine Corps will need to pursue concepts to:⁴⁷

- **Establish and sustain expeditionary advance bases (EAB).** EABs in contested areas can support offensive air operations, cross-domain fires, raids, and logistics support at closer ranges and with potentially greater survivability than naval forces at sea or in the air.
- **Employ cross-domain fires.** Ground-based air defenses and surface-to-surface weapons can transform islands and archipelagos into barriers against adversary power projection and increase the number and complexity of fires attacking enemy forces.
- **Execute raids to assure access.** Potential adversaries are using coastal sensors and weapons to contest the surface and air around their territory. These systems can be difficult to degrade or destroy with air strikes and may need to be raided by amphibious troops launched from defended EABs or outside the contested area.
- **Conduct surface warfare.** Amphibious forces at sea can attack enemy surface combatants with missiles and helicopters to add offensive firepower to U.S. surface forces as well as improve the defense of amphibious ships by challenging enemy surface combatants directly.

The most important of these concepts for the new deterrence approach will be establishing EABs and conducting raids. As shown in Figure 14, EABs could be established and sustained in contested areas to conduct cross-domain fires against enemy ships and aircraft, support forward arming and refueling points (FARP), or launch raids against enemy weapons or other targets.

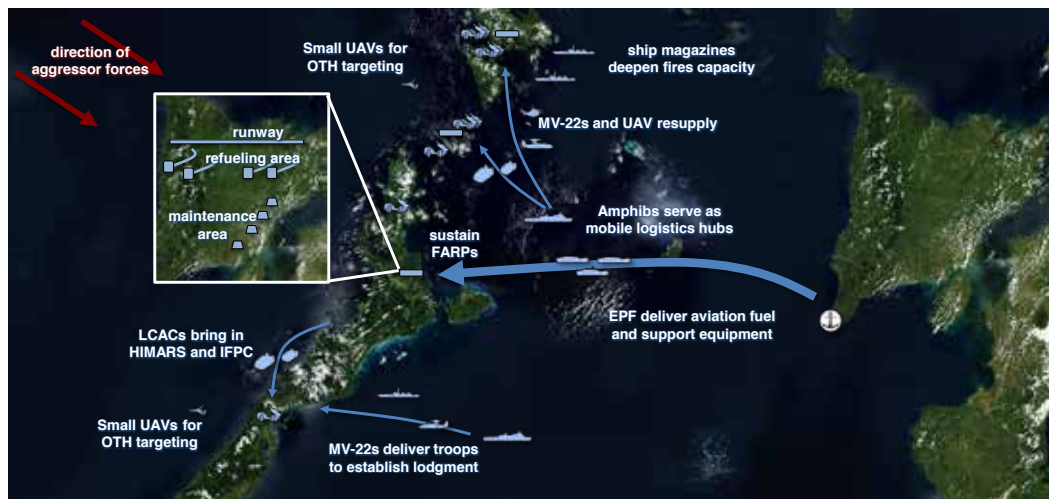
45 Robert Neller, *The Marine Corps Operating Concept: How an Expeditionary Force Operates in the 21st Century* (Washington, DC: Department of the Navy, 2016), pp. 8–10.

46 Megan Eckstein, "Navy and Marines Developing New CONOPs for Contested Littoral Operations," *USNI News*, April 8, 2016, available at <https://news.usni.org/2016/04/08/navy-marines-developing-new-conops-for-contested-littoral-operations>; and U.S. Marine Corps, "Enhanced MAGTF operations," in *Marine Corps Operating Concept*, third edition (Washington, DC: DoD, June 2010), available at https://marinecorpconceptsandprograms.com/sites/default/files/concepts/pdf-uploads/MCOC%201-2%20Enhanced%20MAGTF%20Operations_1.pdf.

47 These concepts and their implications for Navy–Marine Corps capabilities are detailed in Bryan Clark and Jesse Sloman, *Advancing Beyond the Beach: Amphibious Operations in an Era of Precision Weapons* (Washington, DC: Center for Strategic and Budgetary Assessments, 2016).

The Marine Corps' concept for Distributed Short Takeoff and Vertical Landing (STOVL) Operations (DSO) would employ FARPs and amphibious ships to conduct air operations forward in contested areas. Under this concept, STOVL F-35B aircraft would deploy from an amphibious assault ship (LHA/LHD) to a FARP and conduct several sorties for strike, close air support, or air defense operations. The aircraft will rotate back to the LHA/LHD after several sorties to reduce their vulnerability to attack on the ground, enabling them to be maintained onboard ship.⁴⁸

FIGURE 14: ESTABLISHING EABS IN CONTESTED AREAS



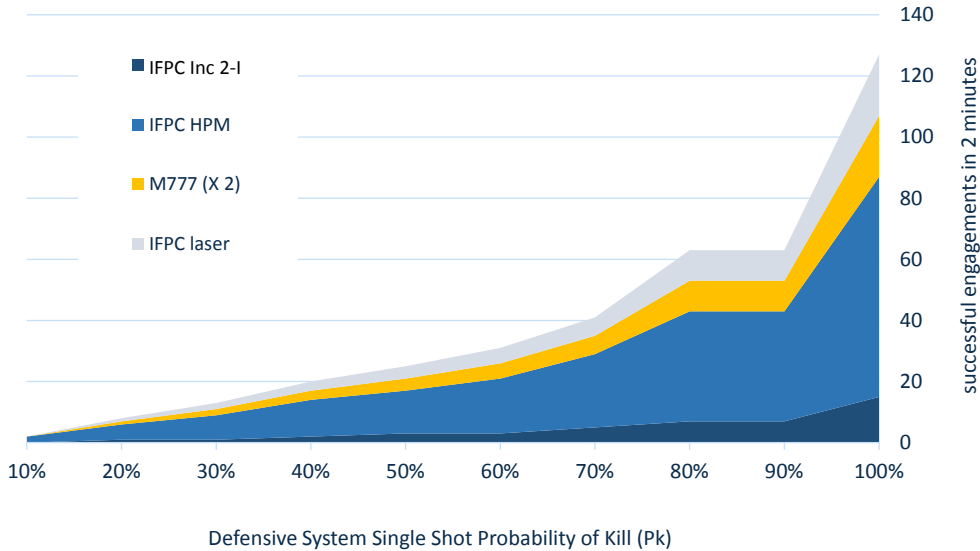
EABs or FARPs could be defensible in contested littoral environments such as the South China Sea. Each EAB would have multiple targets that must be engaged to defeat it, such as C2 facilities, missile launchers, aircraft, fuel bladders, and radars. To further increase the number of potential aimpoints, EABs could be concealed in terrain and protected with similar short-range air defense and counter-ISR systems as described above for forces at sea. In addition, camouflage, physical decoys, and jammers could be used on the base to create more potential targets an enemy would have to engage. These systems do not need to be perfect; decoy targets only require enough fidelity that the enemy would need to attack them in addition to the real targets to ensure all threats are destroyed. Jammers and camouflage only need to degrade enemy sensors enough to make real targets indiscernible from decoys.

Air defenses for EABs include the Army Indirect Fires Protection Capability (IFPC) and HVPs that can be shot from the Marines' current M777A howitzers. These systems only need to drive up the size of strike salvos needed to defeat an EAB, rather than provide an insurmountable

48 Robert Owen, "Distributed STOVL Operations and Air-Mobility Support," *Naval War College Review* 69, no. 4, Autumn 2016, pp. 30–32.

defense.⁴⁹ As shown in Figure 15, even a relatively modest set of air defense systems can increase the number of weapons needed to defeat an EAB to over two dozen per target. In this case, however, the attacker would not know which weapons would be intercepted or miss their targets. The attacker would need to send two dozen weapons at each aimpoint on the EAB to fully defeat the base.

FIGURE 15: NUMBER OF WEAPONS NEEDED TO DEFEAT EAB DEFENSES⁵⁰



As with surface forces in the AMD concept above, the large number of weapons needed to suppress multiple distributed EABs could exceed what the aggressor is willing to expend early in a conflict on a relatively small target.

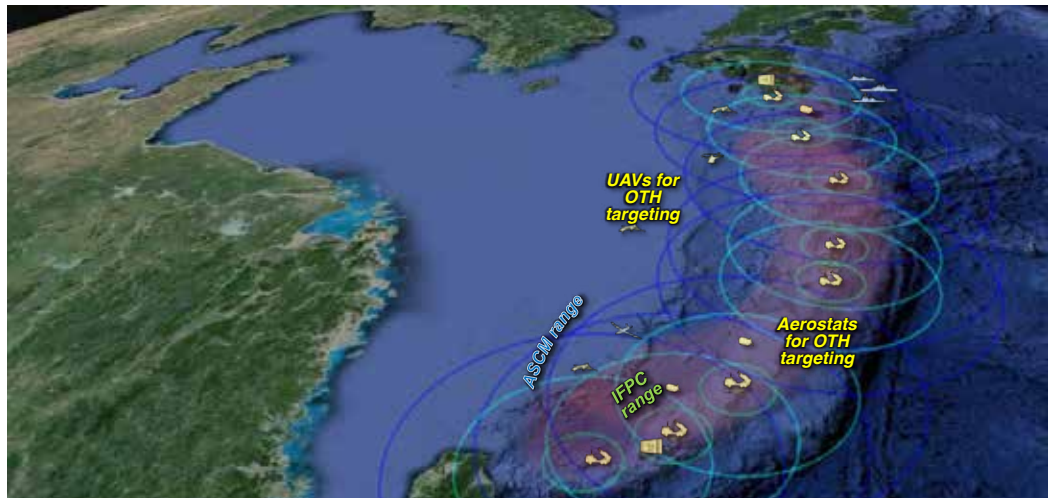
EABs can be used to support raids, provide air defenses to expeditionary forces, or deliver surface-to-surface fires as part of the Navy’s Distributed Lethality concept. An application that could be useful to deterring adversary aggression would be to place EABs with ASCM-equipped missile launchers such as the Army High Mobility Artillery Rocket System

49 The IFPC consists of a 5-ton medium tactical vehicle carrying the 15-cell multi-mission launcher. IFPC Increment 2-Intercept (2-I) uses the Stinger or AIM-9X missile as the interceptor. The Army plans future IFPC increments to carry laser or HPRF weapons. See Sydney J. Freedberg Jr., “Lasers vs. Drones: Directed Energy Summit Emphasizes the Achievable,” *Breaking Defense*, June 23, 2016, available at <http://breakingdefense.com/2016/06/lasers-vs-dronesdirected-energy-summit-emphasizes-the-achievable/>. The HVP is an artillery round that can achieve hypersonic muzzle velocities (more than Mach 5), which would enable it to be shot in front of incoming missiles. The HVP would either directly hit the incoming weapon or (more likely) explode and use shrapnel to damage the missile and send it off course.

50 This chart assumes two M777 howitzers able to fire 5 rounds per minute; one high-powered IFPC-mounted microwave (HPM) weapon that can engage 36 weapons per minute; one IFPC-mounted laser that can engage a target every 6 seconds; and one IFPC Inc 2-I based air defense system that can carry fifteen interceptors, which need to be refilled after each salvo.

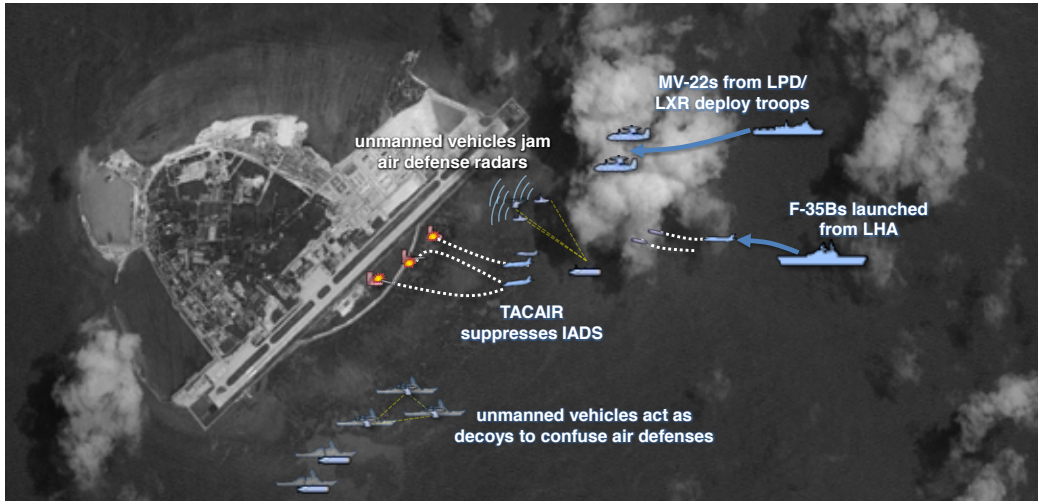
(HIMARS) and IFPC air defenses along an island chain to contain adversary power projection capabilities. Figure 16 depicts this approach in Japan's Southwest Islands.

FIGURE 16: USE OF EABS TO CONTEST ACCESS ACROSS A LITTORAL AREA



Raids against targets such as island airfields, coastal defense cruise missile (CDCM) sites, and radar facilities will be another category of important amphibious missions, as shown in Figure 17. These operations could support efforts to deny aggressor objectives by degrading threats to U.S. forces intervening on behalf of allies. Raids could also punish the aggressor by destroying or damaging military capabilities that aren't involved in the immediate conflict. Moreover, operations to establish EABs will sometimes be like raids, depending on the level of adversary threat in the area.

Amphibious raids will require fires that can reach as far as amphibious troops are required to travel. Against enemy forces equipped with ASCMs, amphibious ships will need to launch raids and assaults from more than 300 nm away. The MV-22B tilt-rotor aircraft can carry Marines more than 400 nm round-trip on a combat mission or more than 1000 nm on a one-way operation. At those ranges, the only amphibious capability to strike enemy defenses in advance of troops landing, or for close air support to Marines in combat, is the F-35B. Today's LHA/LHDs, however, only normally carry six F-35Bs, which will not be enough to support long-range fires for multiple raids or to establish more than one EAB at a time. Amphibious forces will need more long-range fires and greater strike aircraft capacity.

FIGURE 17: AMPHIBIOUS RAIDS IN CONTESTED AREAS

Long-range fires will also improve the ability of amphibious forces to support surface warfare. As part of U.S. efforts to deny and punish adversary aggression, amphibious forces will increasingly be expected to conduct anti-ship attacks from strike-fighters. To further increase SUW capacity, amphibious ships could be equipped with VLS magazines that can carry air defense and surface-to-surface missiles such as Tomahawks. Helicopters from the ARG can also conduct SUW against fast attack craft (FAC) that could engage naval forces in littoral waters such as the Persian Gulf, Mediterranean Sea, or South China Sea.

Enabling new concepts for amphibious operations in highly contested areas will imply significant changes to the posture of the future fleet. Most significantly, entering a contested area to establish EABs or conduct raids will be very difficult after a conflict starts. Therefore, amphibious forces will need to be present in the region, establishing and disestablishing EABs in peacetime and practicing the kinds of operations they will conduct in wartime. This will require a more robust and focused posture of amphibious forces.

Implications for Fleet Architecture

Amphibious forces are only one area in which today's fleet architecture will need to evolve. The need for naval forces to shift to a denial and punishment approach to deterrence and adopt new operational concepts for key naval missions will drive changes in the composition and posture of the fleet across the board. In particular, these concepts will require new force packages positioned to act quickly to counter adversary aggression. These implications will be described in the following chapters.

CHAPTER 4

The Organization of the Deployed Fleet—The Deterrence Force and the Maneuver Force

Significant changes to the U.S. Navy’s fleet architecture, as well as new strategic and operational concepts, are needed to address an emerging era of great power competition. These changes will be most apparent in the Navy’s deployed forces, since they are the front line of conventional deterrence and the first forces to respond to crisis or aggression. Given the short timelines in which aggression could occur and escalate against U.S. allies in East Asia, the Middle East, and Europe, the size and composition of deployed naval forces may make the difference between an adversary being deterred or perceiving an opportunity to act. Furthermore, as described in Chapter 2, nuclear deterrence may not be as effective in the kinds of limited conflicts China, Iran, or Russia may initiate. It will remain important, however, for managing and controlling escalation once a conflict begins.

The Fleet of Today

Today’s deployed fleet reflects the security concerns and warfighting approaches of the post-Cold War era. The Navy today faces a diverse set of relatively unchallenging threats from regional powers and terrorists and employs strike warfare almost exclusively to address them. The deployed naval force also reflects a change in the Navy’s role, brought about by the Goldwater–Nichols Department of Defense Reorganization Act of 1986,⁵¹ from directly operating the overseas fleet to being a force provider for the CCDRs. The Goldwater-Nichols

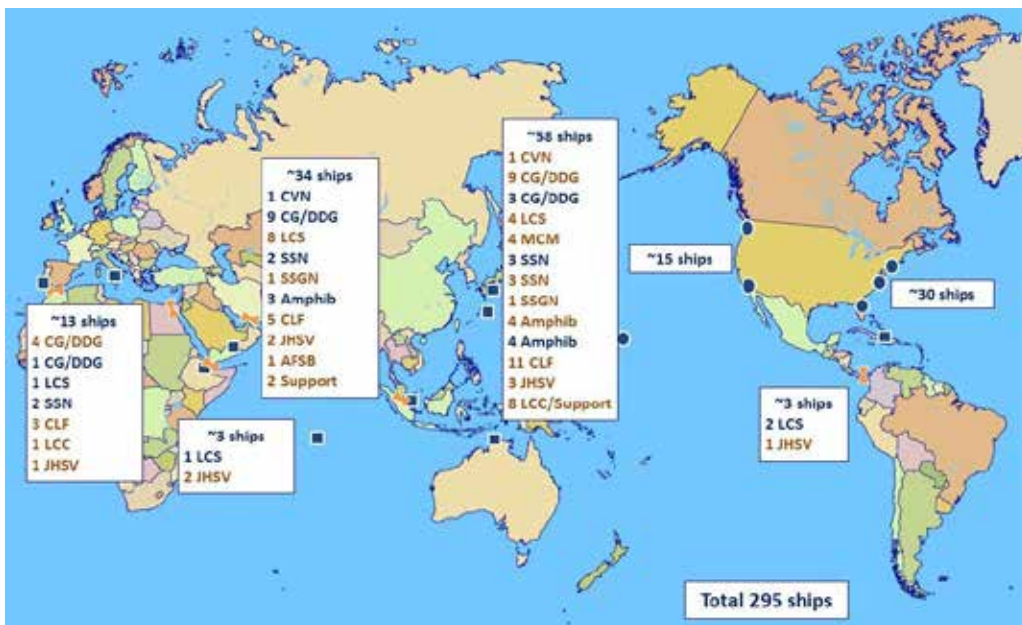
51 Goldwater-Nichols Department of Defense Reorganization Act of 1986, Pub. L. No. 99-433, 100 Stat. 992 (1986), available at http://history.defense.gov/Portals/70/Documents/dod_reforms/Goldwater-NicholsDoDReordAct1986.pdf.

Act was designed, in part, to increase the role of operational commanders in designing and posturing the force, and it has succeeded in doing that. One consequence is that contemporary concerns and conditions affect force development and management decisions to a greater degree than they did during the Cold War.

The Navy's role as force provider over the last 30 years changed the deployed fleet's use to be contingent on the operational needs of CCDRs. The Navy eventually designed its force structure requirements around projected demands for naval presence from CCDRs and built its readiness processes to continue efficiently preparing and providing that presence. CCDRs wanted versatile forces that could support peacetime maritime security and disaster response operations while deterring smaller regional powers. These could be met with multi-mission CSGs, ARGs, and BMD SAGs, so the Navy built its FRTP to maintain, equip, and train those groups to address current threats. CCDRs then placed them as needed to address their near-term challenges and opportunities.

Figure 18 depicts today's average overseas naval presence. It is organized by CCDR AOR and reflects the priority of efficiency over effectiveness. Ships in brown text are either forward-based or forward-stationed with rotational crews, which provide more presence per ship than a single-crewed ship. The emphasis overall is on the amount of presence in each CCDR AOR, rather than the complete overseas posture of naval forces, capabilities, and readiness.

FIGURE 18: AVERAGE DEPLOYED U.S. NAVAL PRESENCE IN 2015⁵²

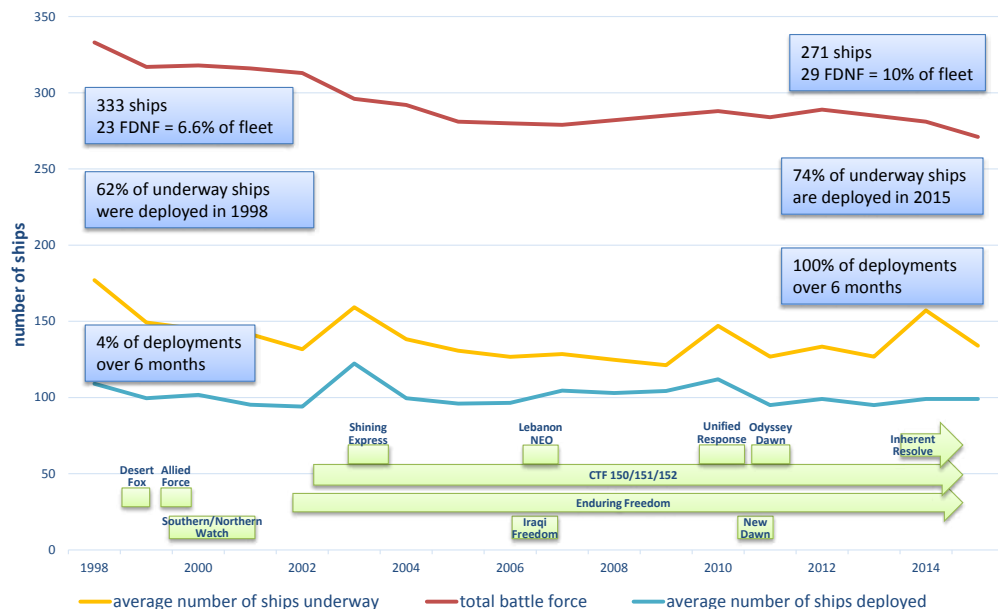


⁵² This is based on charts maintained on the Navy's web page and presented by the then-CNO, Admiral Jonathan Greenert, in Congressional hearings. Ships in brown font are homeported forward and counted as continuously present, or forward-stationed and rotationally crewed, enabling a single ship to remain deployed longer before returning to its homeport in CONUS after several crew rotations. Ships in blue text rotationally deploy from CONUS.

As Figure 18 indicates, naval presence is focused on the Middle East and Western Pacific, with one CSG and one or two ARGs continuously deployed in each. These forces are intended to deter regional powers such as North Korea or Iran by demonstrating the potential to deny or punish their aggression. Against more capable powers such as Russia or China, naval presence forces are intended to simply be the leading edge of the eventual mobilization that will respond to aggression after the act.

A fundamental weakness of the “one-size-fits-all” model of using CSGs and ARGs for all operations in a theater is that deterring and responding to great power aggression will likely require the ability to conduct an initial phase of high-capacity, short-duration offensive and defensive operations. A CSG or ARG, however, is designed to sustain combat operations at a moderate level for a very long time. In a 1- or 2-day opening phase of a conflict they could be subjected to continuous bombardment with ASCMs and ASBMs. Although these forces would likely survive, they would use their capabilities and mobility primarily in defense rather than offensively, potentially enabling the aggressor to achieve a *fait accompli*.

FIGURE 19: NAVAL PRESENCE AND FLEET SIZE SINCE 1998



As a force provider, the Navy is under pressure to maintain presence levels, even at the expense of capabilities needed to deter aggression. This was made more difficult during the past 20 years, because the fleet shrank by about 20 percent, whereas CCDR demands remained steady or grew. As shown in Figure 19, the Navy has met a constant demand of about 100 ships deployed since the 1990s by basing more overseas and deploying from the continental United States and Hawaii longer and more frequently. For example, in 1998 only

4 percent of the Navy's deployments were longer than 6 months; today all are.⁵³ Over the last 5 years, this approach became unsustainable. The material condition of ships suffered, requiring longer maintenance periods and, in turn, reducing the time available for training in preparation for deployment.⁵⁴ This degrades the fleet's ability and proficiency in the kind of high-end combat operations needed to deter a great power such as China or Russia.

A New Structure for the Fleet

To address the challenges posed by Russia and China, the Navy will need to focus on sustaining an effective posture for conventional deterrence rather than an efficient presence to meet near-term operational needs. The posture should address the most significant shortfalls of today's presence-based approach: it does not necessarily position the right capabilities in the right places at the right time to counter great power aggression, nor does it provide the time or ability for the fleet to maintain its material condition, become proficient, and adapt to dynamic and capable adversaries.

To determine future posture requirements, the CSBA study team put itself in the position of the CCDR of 2030, rather than the force provider of 2016. This allowed us to determine the future demands that should drive acquisition, readiness, basing, and personnel management decisions over the next 15–20 years. This long view is necessary because ships and aircraft take years to procure and last for decades, and organizational and basing changes take up to a decade or more to fully implement.

In place of the single presence force of Figure 18 that is organized into broad CCDR AORs, this study proposes dividing the deployed fleet into two main groups: a "Deterrence Force" that is organized into discrete regions rather than CCDR AORs and a "Maneuver Force" that is assigned broadly to the Indo–Asia–Pacific theater. Separating the deployed fleet into these two main forces enables Deterrence Forces to be tailored to their region, since they will not "swing" to another theater in a conflict. And because Deterrence Forces will remain in their region, the Maneuver Force is able to respond to tensions and conflict in any part of the Indo–Asia–Pacific, including the Middle East, without leaving an opening for opportunistic aggression by an adversary seeking to exploit the shift in U.S. focus to the area of conflict.

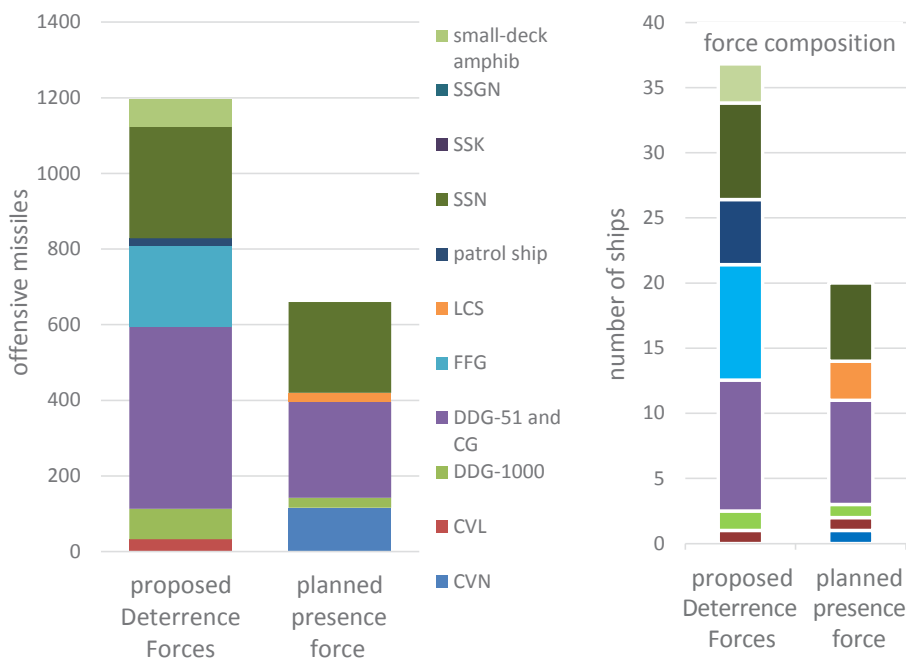
53 Data from CSBA's analysis of fleet deployment was obtained through a Freedom of Information Act request from the Navy Times and, additionally, from Daniel Whiteneck, Michael Price, Neil Jenkins, and Peter Schwartz, *The Navy at a Tipping Point: Maritime Dominance at Stake?* (Alexandria, VA: Center for Naval Analysis, 2010). See also, Congressional Budget Office (CBO), *Preserving the Navy's Forward Presence with a Smaller Fleet* (Washington, DC: CBO, March 2015), p. 9.

54 Rear Admiral Joseph F. Campbell, "Readiness and Sustainment of the Navy's Surface Fleet," hearing before the House Armed Services Committee, Readiness Subcommittee, March 25, 2009. See Megan Eckstein, "Admirals: Fleet Readiness Plan Could Leave Carrier Gaps, Overwhelm Shipyards," *USNI News*, September 9, 2016, available at <http://news.usni.org/2015/09/09/admirals-fleet-readiness-plan-could-leavecarrier-gaps-overwhelm-shipyards>; and Bill Gortney, "Predictability and Adaptability: West 2014," Power Point Presentation, United States Fleet Forces, February 12, 2014, available at <http://www.afcea.org/events/west/14/documents/WEST2014PresentationFinalGortney.pdf>.

For example, if tensions rise with North Korea, the Maneuver Force could deploy to the Sea of Japan without affecting the ability of naval forces to deter in the South China Sea or Middle East. Today, tensions on the Korean Peninsula could require moving the Pacific CSG to the Sea of Japan and moving the Middle East CSG to the Pacific for deterrence of China. Iran could perceive the movement of almost all naval forces out of its region as an opportunity to pursue aggression in the Persian Gulf while the United States is focused on Korea.

Operationally, separating the deployed fleet into Deterrence Forces and the Maneuver Force enables commanders to take advantage of the capability and capacity strengths of different elements of the fleet. Specifically, CSGs are designed to deliver sustained combat power at moderate levels over an indefinite period using the CVW, protected by DDGs and CGs. Surface combatants can also contribute some missile-based fires as part of the CSG, but most of their VLS magazines will be dedicated to air defense weapons. This suggests CSGs should not be in Deterrence Forces, where prompt, high-capacity fires would be needed to deter an adversary such as China or Russia seeking a rapid *fait accompli*. CSGs would be needed, however, in the Maneuver Force because of their ability to deliver sustained volumes of fire at long range to back up Deterrence Forces.

FIGURE 20: COMPARISON OF OFFENSIVE WEAPONS CAPACITY IN THE WESTERN PACIFIC



Deterrence Forces should consist of surface combatants in SAGs that can devote more VLS capacity to strike and SUW weapons, combined with submarines and amphibious ships carrying offensive weapons. The comparison in fires between the Navy’s planned presence force and the proposed Deterrence Forces is shown in Figure 20, which depicts the number of strike and SUW weapons that could be delivered in the first 2 days of a conflict, assuming the proposed Deterrence Forces are using the new air defense approach described in Chapter 3.⁵⁵

As the figure shows, Deterrence Forces can generate about twice the fires of the planned carrier-centric force—but can only do so once before the ships and submarines need to leave the conflict to reload. Deterrence Forces would be able to survive long enough to expend these offensive weapons because they use the higher-capacity medium-range air defense concept described in Chapter 3. This enables them to deny and punish enemy aggression initially until they can be relieved by the Maneuver Force and other elements of the Joint Force.

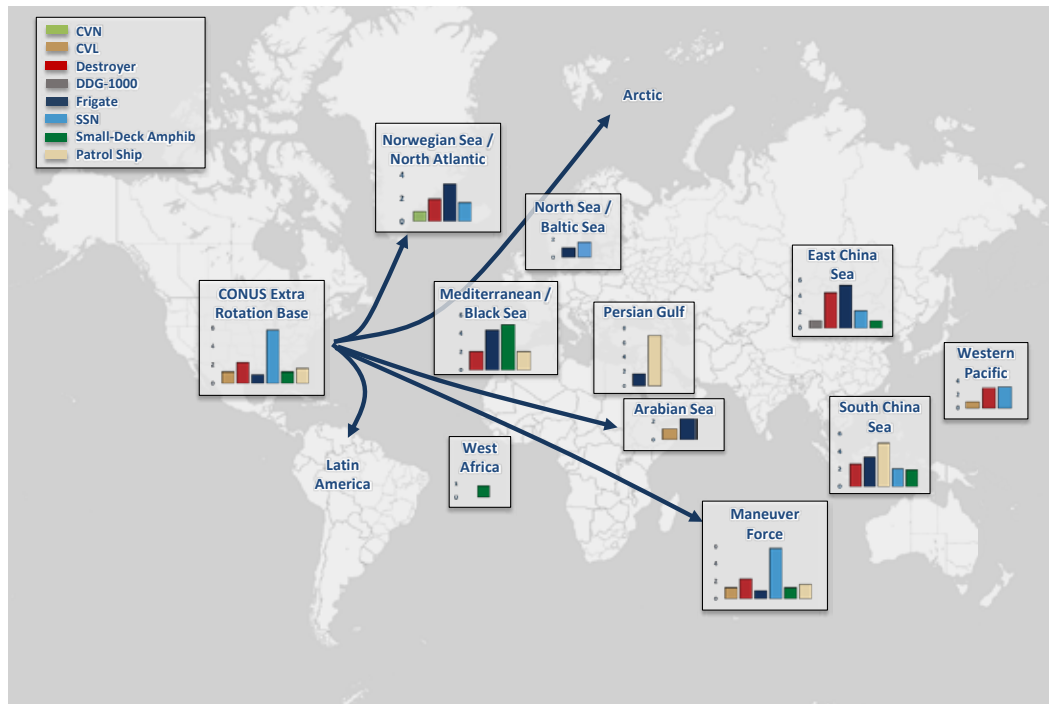
The Deterrence Forces described below are focused on conventional deterrence, given the concern that nuclear deterrence may not be effective in the kinds of scenarios great power competitors are most likely to present. Nuclear forces would continue to be needed, however, as the ultimate backstop for U.S. deterrence. Those forces are considered separately from the Maneuver and Deterrence Forces described below, and they will be unchanged from the Navy’s current plan of sustaining twelve nuclear ballistic missile submarines (SSBN).

The Deterrence Force

Deterrence Forces are deployed as depicted in Figure 21. As mentioned above, they are tailored to the threats and opportunities specific to their region. This should enhance their ability to establish and gain proficiency in the operations most likely needed in their region, to learn by observing adversary operations up close, and to build relationships and interoperability with allies and partners in their region. Further, the alignment of Deterrence Forces in regions that are smaller than CCDR AORs would enable them to focus on a more discrete set of factors than today’s fleet. For example, the demands and dynamics of the East China Sea differ from those of the South China Sea or Indian Ocean. A single force spread across the Pacific Command (PACOM) AOR, as it is today, is much less knowledgeable about the dynamics in each region of the AOR and has less time to devote to training for the wide range of most likely operations across regions.

55 This figure assumes targets are between 300 and 1000 nm away from the launch platform, CSG surface combatants devote 50 percent of their VLS magazine to air defense, and SAG surface combatants devote 33 percent of their VLS magazine to air defense: consistent with the chart in Chapter 3 describing the new air defense scheme. Figure 20 assumes at these ranges that a CVW can generate seventeen strike aircraft, each carrying four Small Diameter Bombs (SDB), and a CVL (LHA/LHD) carrying twenty F-35Bs can generate seven strike aircraft. See Seth Cropsey, Bryan McGrath, and Tim Walton, *Sharpening the Spear: The Carrier, the Joint Force, and High-End Conflict* (Washington, DC: Hudson Institute, 2016), p. 41.

FIGURE 21: DETERRENCE FORCE REGIONS



To maximize the naval posture in each region and improve operational proficiency, Deterrence Forces would use a higher OPTEMPO readiness model similar to the one employed today by U.S. FDNF in Europe, the Middle East, and the Western Pacific. This model is challenging to sustain today because of the wide range of responsibilities assigned to the FDNF across an entire CCDR AOR. By focusing more narrowly on a specific region within the AOR, Deterrence Forces would be better able to maintain their proficiency.

The composition of Deterrence Forces would be designed to address local conventional deterrence and reassurance requirements. Although these units would conduct the day-to-day operations that arise in the region, such as maritime security, disaster response, or counterterrorism, these missions are not primary determinants of each Deterrence Force's structure. Operationally, Deterrence Forces would be designed to stop adversary aggression on or from the sea by defending themselves well enough to expend their offensive weapons before safely withdrawing. Unlike today's CSGs and ARGs, deterrence fleets would be designed for high-capacity, short-duration combat at the opening of a conflict and therefore could better deter aggression against adversaries such as China or Iran that may desire a short, sharp war.

After their initial combat operations, affected Deterrence Forces would move to the periphery of the region to rearm, refuel, and prepare to execute sea control operations at the edges of the conflict theater. This could include protracted operations such as blockades to deny the adversary's access to resources, lines of production, and battlefields while ensuring maritime access for U.S. and allied forces.

The mission of the Deterrence Forces and their intended operational use suggest they would prioritize capabilities for SUW, ASW, undersea warfare, AMD, mine warfare, and amphibious operations, while maintaining some capacity for intra-theater strike. They would consist of surface combatants, submarines, amphibious forces, and associated aircraft and unmanned systems. These capabilities would enable a Deterrence Force to interdict enemy naval forces, attack coastal targets supporting aggression, or destroy valuable coastal targets to punish the enemy. These forces will be described in detail by region in the next Chapter.

The Maneuver Force

The Maneuver Force would consist of a multi-carrier task group that is part of the deployed fleet but not assigned to a particular region. It is not a surge force based in CONUS, but rather a reconfiguration of the CSGs normally deployed today in the Central Command (CENTCOM) and PACOM AORs. Instead of consisting of one CSG stationed in each of those CCDR AORs, the two-CSG Maneuver Force is able to move as needed throughout the broader Indo–Asia–Pacific theater, providing national leaders and CCDRs more flexibility regarding its employment. It is able to have this flexibility because Deterrence Forces are primarily responsible for conventional deterrence and day-to-day operations in their respective regions.

The Maneuver Force would contain the preponderance of the fleet’s strike capabilities, which could be employed for power projection and offensive sea control. It would be an essential complement to Deterrence Forces in preventing great power aggression. Without the prospect of the Maneuver Force arriving within days from over the horizon, an adversary might be willing to suffer the losses imposed by Deterrence Forces in order to accomplish its objective before the U.S. Joint Force was able to mobilize.

In peacetime, the Maneuver Force would conduct many of the same large-scale exercises as today’s presence force such as Malabar, Talisman Sabre, or Rim of the Pacific. Because it would not be assigned to a specific region, the Maneuver Force’s schedule could support large-scale experimentation and multi-carrier training events alone or with the Deterrence Forces in applicable regions. It would work with select allies, shore-based centers of strategic and conceptual development such as the U.S. Naval War College, and other Services to explore and test operational concepts in advancing the art of high-end multi-dimensional war at and from the sea.

In periods of tension or crisis, the flexibility of the Maneuver Force would enable it to be postured to demonstrate U.S. resolve, deter aggression, and reassure allies and partners. In conflict, the Maneuver Force would join the affected Deterrence Force at about the same time the Deterrence Force expends its offensive and defensive capacity. The Maneuver Force would then conduct sustained high-end warfare, augmented over time by additional surge forces from CONUS. Because the Maneuver Force must be prepared for a wide range of potential operations and scenarios, it would use a longer readiness and training cycle, similar to that of today’s Optimized Fleet Response Plan (OFRP). Readiness cycles for Deterrence and Maneuver Forces are detailed in Chapter 9.

CHAPTER 5

Naval Posture

The proposed fleet architecture uses a deployed fleet of Deterrence and Maneuver Forces to deny aggressors the objectives of their aggression, or at least delay them until the United States and its allies can reinforce U.S. naval forces and halt the aggression. At the same time, deployed naval forces need capabilities to punish adversaries for their aggression both in the region of the initial conflict and globally to increase the costs of continued attacks on U.S. allies and partners.

The size and composition of deployed naval forces, their deployment locations, and their overseas basing create an overall naval posture. In contrast to today's emphasis on the number of ships present in a CDR AOR, posture connotes an overall capability to conduct and sustain combat operations. In a period of great power competition, posture—not presence—will need to be the focus of a future fleet architecture.

The Deterrence Force posture in each region is designed to sustain the ability to promptly deny adversaries their likely objectives and attack targets the enemy would value. The characteristics of Deterrence Forces are focused on great powers such as China and Russia but address strategically located regional powers such as Iran or North Korea. Perhaps more importantly, however, Deterrence Force naval posture includes the attributes needed to reassure allies and partners of U.S. resolve and capability to defend their interests. In peacetime, Deterrence Forces would conduct day-to-day operations such as maritime security and disaster response, particularly with the maritime forces of allies and partners, but these missions do not drive the composition of Deterrence Forces.

The posture of Deterrence and Maneuver Forces also address requirements for wartime surge. As with today's fleet, surge demands would normally be met using non-deployed forces in various stages of the maintenance and training cycle. For example, units that just returned from deployment or are completing their training and preparations at the time of a conflict could immediately augment deployed forces, whereas units in deep maintenance would take longer to join the fight. One exception to this approach would be the CLF, which does not have

a training and maintenance cycle to draw from for wartime surge. CLF surge requirements will be addressed in the section on logistics forces below.

This chapter introduces ten regionally tailored Deterrence Forces. It identifies the operations needed to deter and respond to aggression in each region and the number and types of force packages needed to conduct these operations using the new operational concepts of Chapter 3. It then translates these force packages into an overall number of platforms and payloads required in a particular region.

Each Deterrence Force is described using a table, as modeled in Table 1. It lists each platform deployed in the region and the number that are in operation on any given day. Fractional numbers for operational presence indicate a higher level of presence for part of any given year; i.e., 1.5 DDGs indicates 2 DDGs are operational in the region half the year, and only one is operational the rest of the year. In each of the below tables, “operational presence” does not include all forces that may be based or stationed in a theater. It only includes units that are operating, which on any given day may be only half the units that are based in the region.

TABLE 1: EXPLANATION OF DETERRENCE FORCE TABLES

Regional Deterrence Force	
Ship or aircraft type	Operational Presence
Ex. DDG	1.5

This study proposes two types of forward basing in each region, similar to the basing models used by naval forces today. *Forward-based* forces are homeported in the region, such as in Japan or Spain today with crews and dependents living in the region near the homeport. *Forward-stationed* forces use rotational crews from CONUS to operate platforms that remain forward for several crew rotations, similar to how LCSs or SSGNs are crewed today. Civilian-crewed vessels of the Military Sealift Command (MSC) such as logistics ships, unmanned vehicle support vessels, or afloat forward staging bases also use rotational crews and are considered forward-stationed ships in this study. MSC ships are identified in the tables below. The operational presence of ships that are not forward based or stationed is provided by forces rotationally deploying from CONUS, as described in Chapter 8.

Basing is used in the new architecture to support Deterrence Force operations, as well as to promote reassurance and interoperability with allies. Forward-based and forward-stationed forces demonstrate U.S. resolve and provide more opportunities to operate with host nation navies and prepare for combined operations. Basing associated with each Deterrence Force is described using maps for each region or combination of regions.

North and South America Deterrence Force

The Deterrence Forces operating around North and South America would support U.S. homeland defense and security by maintaining patrol ship and frigate presence in the

Caribbean and Eastern Pacific, respectively. These forces would conduct frequent port calls in Central and South America, continuing longstanding U.S. relationships with navies in the Americas and supporting the homeland defense and security efforts of the U.S. Coast Guard and the U.S. Customs and Border Patrol.

TABLE 2: AMERICAS DETERRENCE FORCE COMPOSITION

North and South America Deterrence Force	
Ship	Operational Presence
Frigate (from CONUS)	1.0
Patrol Ship (from CONUS)	1.7

The Americas Deterrence Forces will be based in CONUS, and additional forces for surge maritime security and disaster response operations would be drawn from the CONUS rotation base or from other ships passing through the theater. As will be discussed later in its chapter, the Maneuver Force would often conduct training and exercises off the U.S. coast.

Northern Europe Deterrence Force

The primary driver for the posture, capabilities, platforms, and basing of the Deterrence Force in Northern Europe is a resurgent Russia. The challenge of deterring Russia from coercing or invading NATO allies has been complicated by the expansion of the alliance to the Baltic region.⁵⁶ Given the limited geographic depth of the Baltic states, speed of response will be of the essence. Cuts in NATO force levels since the Cold War and expansion of NATO mean the alliance must defend more territory with fewer forces and more parties involved in decision-making.⁵⁷ Although NATO has been a bulwark of European security and stability for decades, swift consensual decision-making and rapid operational employment in the face of looming crises have never been among its strengths, a characteristic Russia knows well and has exploited in the past.⁵⁸ The credibility of U.S. deterrence will likely depend on the ability to promptly respond with U.S. naval forces not bound by host nation limitations in NATO countries.

The key objectives for the Deterrence Force in Northern Europe would be twofold: preparing for rapid unilateral action to deny or delay the movement of Russian forces and degrade Russian C2; and tracking and defeating relatively small numbers of highly capable Russian submarines operating in the North Atlantic. Preparing for unilateral action includes training, coordinating, and executing combined operations with NATO members and partners,

56 Shlapak and Johnson, RR-1253-A.

57 Rem Korteweg and Sophia Besch, "No Denial: How NATO Can Deter a Creeping Russian Threat," Center for European Reform, *Insights*, February 9, 2016, available at <http://www.cer.org.uk/insights/no-denial-how-nato-can-deter-creeping-russian-threat>.

58 Mike Krever, "Norwegian Defense Minister: NATO Decision Making Process Too Slow to Deal with Emerging Crises," *CNN*, March 2, 2015, available at <http://www.cnn.com/2015/02/25/world/amanpour-norway-ine-eriksen-soreide/index.html>.

The Northern Europe CSG would consist of a 100,000-ton CVN and its embarked CVW, two DDGs, and two FFGs. To meet the needs of the North Atlantic and Baltic theaters, the embarked CVW would be focused on long-range AAW against enemy bombers and close air support (CAS) of NATO troops. CSG surface combatants would employ the medium-range air defense concept described in Chapter 3 and carry new air defense weapons such as HPRF and HVP rounds for naval guns; this will enable them to free up some VLS magazine space for offensive missiles to augment CVW strikes.

Russian C2 facilities, air defense sites, and ground forces. It would also include force packages for countering Russian ISR and tracking and engaging Russian submarines. The Northern European Deterrence Force is the only one that includes a CVN or CSG. Naval aircraft are needed to enable responsive CAS missions in support of NATO allies in the Baltic region. If the Russian threat does not manifest to the same degree assumed by this study, the CVN presence in the Northern Atlantic could be reduced.

It is to be expected that Russian space and airborne sensors would search for Deterrence Force units in the North Atlantic and Norwegian Sea to enable attacks by bombers and submarines with ASCMs, and possibly ASBMs in the future. To obscure U.S. ships and dilute enemy strikes, the Deterrence Force will rely upon Counter-ISR Groups employing the EMS warfare operational concepts described in Chapter 3.

The other main mission of this Deterrence Force would be offensive ASW against Russian SSNs attempting to break out of the Norwegian Sea to threaten U.S. forces and homeland targets in the Atlantic. This mission would be conducted by dedicated ASW Groups using the approach to ASW described in Chapter 3. These groups would also provide defensive ASW capabilities to the Deterrence Force CSG operating in the North Atlantic.

In the Baltic Sea, Counter-ISR Groups would monitor the Russian EMS order of battle and confuse Russian sensors. Working with allied and partner naval forces, Offensive Mine

particularly those with highly professional and advanced navies and air forces or niche capabilities such as ASW, long-range strike, and land-based anti-air warfare (AAW) and counter-ISR capabilities. Apart from these critical capabilities, their knowledge of local conditions will be indispensable.

The Deterrence Force in the North Atlantic and Norwegian Sea is described in Table 3. This force would be centered on a CSG and attack submarines (SSN) capable of striking

The Counter-ISR Group would include an FFG for C2 with an onboard MALE UAV to act as a highly directional communications relay to reduce the risk of counter-detection. An unmanned vehicle support vessel would carry several CUSVs for decoy and jamming missions against airborne sensors and missiles; it would also support two XLUSVs with large decoy systems designed to confuse enemy electronic intelligence (ELINT) and synthetic aperture radar (SAR) satellites by emulating the RF emissions from U.S. ships.

Warfare Groups would operate regularly in the region to threaten access and stand by to attack Russian naval forces in ports such as St. Petersburg and Kaliningrad.

For offensive ASW, the ASW Group would include several TRAPS passive sonar sensors, an T-AGOS with active LF sonar, and glider or powered XLUUVs with passive towed arrays to detect enemy submarines by their emitted noise or reflected sound from the T-AGOS sonar. In peacetime, two P-8As would track adversary submarines detected by these sensors; in wartime, the P-8As would attack them. For defensive ASW, the ASW Group would find or drive away submarines using LFA VDS carried by an FFG and an XLUSV; LFA sonar returns would be detected by passive towed arrays on the FFG and one to two glider UUVs. Submarines would be engaged by MALE UAVs with torpedoes or with standoff ASW missiles launched from the FFG. An unmanned vehicle support vessel would support the group's unmanned systems.

TABLE 3: NORTHERN EUROPE DETERRENCE FORCE COMPOSITION

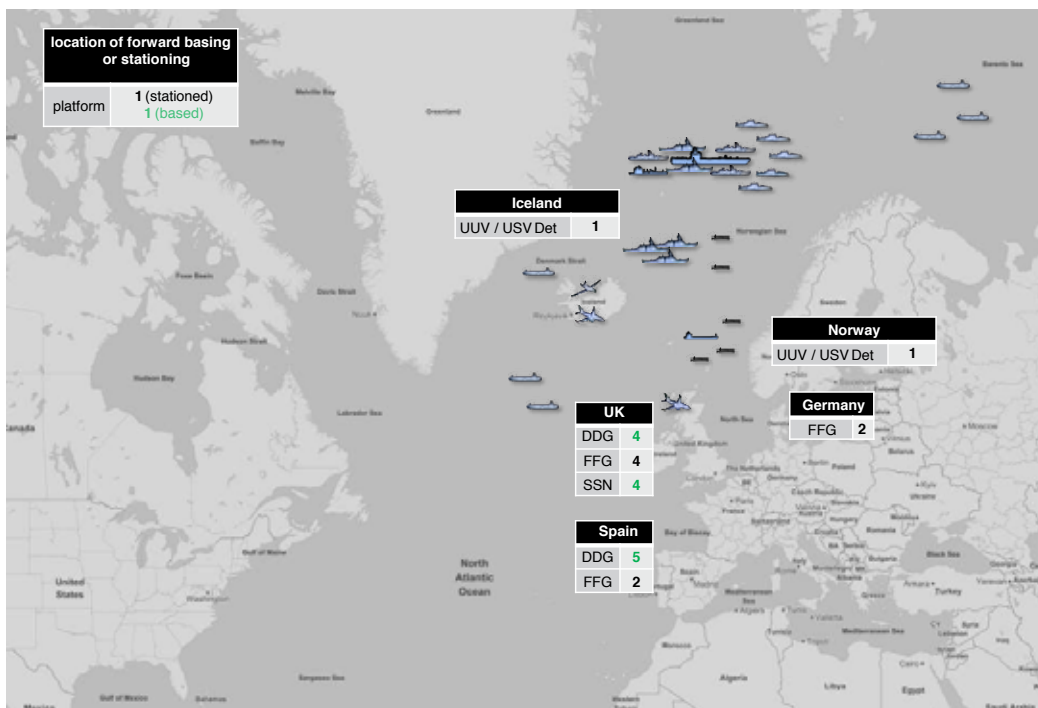
North Atlantic and Norwegian Sea		Baltic Sea	
Ship	Operational Presence	Ship	Operational Presence
CVN	0.9	FFG	1.1
DDG	4.3	XLUSV	2.6
FFG	3.3 (+1.0 NATO)	XLUUV	2.6
XLUSV	5.1	Unmanned Vehicle Support Vessel (MSC)	0.8
SSN	5.6	Salvage / Fleet Tug (MSC)	1.0
XLUUV	5.1	P-8 Detachment	1.0
Large Multi-Product Logistics Ships (AOE) (MSC)	2.5		
T-AKE	1.0		
Unmanned Vehicle Support Vessel (MSC)	2.0		
Unmanned Vehicle Squadron	2.0		
Oceanographic Research Ship (T-AGOS) (MSC)	1.0		
MQ-4 Detachment	1.0		
P-8 Detachment	2.0		

The Offensive Mine Warfare Group would include an FFG for C2 and two to three XLUUVs equipped with micro-UUV smart mines. The XLUUVs would be based ashore or hosted by an unmanned vehicle support vessel in the region.

Additional U.S. naval forces would be forward-based or forward-stationed to support the force packages operating in the North Atlantic and Baltic. An unmanned vehicle detachment and support ship would be forward-stationed ashore in Norway and Iceland; four FFGs, four nuclear

submarines, and a tender would be forward-based in Great Britain. Two FFGs will also be forward-stationed in Spain and in Germany. Figure 22 depicts the forward basing and stationing associated with the new architecture.

FIGURE 22: NORTHERN EUROPE BASING



Mediterranean Sea and West Africa Deterrence Force

The Mediterranean has seen the return of great power naval operations over the last decade. Both Russia and China regularly operate warships there, and Russia will likely continue to have bases on the Crimean Peninsula and in Syria in 2030. The Deterrence Force in this region would not only be focused on direct threats to U.S. allies around the Mediterranean, but also on enabling prompt attacks on Russian and Chinese interests in the region as punishment for aggression that occurs outside the Mediterranean.

The Mediterranean Deterrence Force would be intended to slow or stop Russian aggression against NATO allies such as Romania and Bulgaria and attack Russian naval forces and bases in the Eastern Mediterranean and Black Seas. To deter Chinese aggression, the forces

The SAG would consist of three surface combatants (a DDG and two FFGs), each with an embarked helicopter and two MALE UAVs, and two XLUSVs employing a SIGINT package and towed array for passive targeting.

in the Mediterranean Sea and West Africa Deterrence Force (see Table 4) would threaten Chinese naval forces and seaports, hindering China's access to resources and markets in the event of war.

TABLE 4: MEDITERRANEAN SEA AND WEST AFRICA DETERRENCE FORCE COMPOSITION

Mediterranean Sea		West Africa	
Ship	Operational Presence	Ship	Operational Presence
CVL	1.3	Small Deck Amphibious Ship	1.3
DDG	2.1		
FFG	3.4 (+1.0 NATO)		
Patrol Vessel	5.0		
XLUSV	5.1		
XLUUV	5.1		
Small Deck Amphibious Ship	2.6		
Large Multi-Product Logistics Ships (AOE) (MSC)	3.0		
Unmanned Vehicle Support Vessel (MSC)	3.0		
Unmanned Vehicle Squadron	1.0		
Tender (MSC)	1.0		
Salvage / Fleet Tug (MSC)	1.0		
MQ-4 Detachment	1.0		
P-8 Detachment	2.0		

The Mediterranean force would include two SAGs employing the operational concepts for SUW and strike described in Chapter 3. They would also be able to support responsive BMD missions for NATO allies, although these missions would normally fall to Aegis

The Littoral Combat Group would consist of an FFG with medium-range air defense capabilities and three MALE UAVs for passive targeting as well as three patrol vessels equipped with long-range anti-ship/strike missiles to engage targets at sea and ashore.

Ashore facilities in Eastern Europe. Among other critical capabilities, NATO allies would be expected to contribute FFGs to the SAG for day-to-day operations and contingencies against Russia. Two Littoral Combat Groups would support maritime security operations in peacetime and operate in coastal areas to supplement SUW and strike in wartime.

The SAGs and Littoral Combat Groups would be complemented by a 4-ship ARG tailored to conduct distributed amphibious operations and small-scale SUW and strike in the Mediterranean and North Africa.

The 4-ship ARG would consist of a CVL, an LPD, and two LX(R)s. The CVL would initially be a legacy LHA/LHD but would eventually be replaced by a purpose-built 40,000- to 60,000-ton CVL with catapults and arresting gear. The CVL would carry twenty to thirty primarily fixed-wing aircraft to exploit the stealth and C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance) capability of the F-35B. The rotary-wing aircraft displaced from the LHA/LHD would go to a small-deck amphibious ship (LPD or LX(R)) added to the current 3-ship ARG. The CVL air wing would focus on SUW, strike, and CAS missions. The LPDs and LX(R)s would conduct SUW as well as amphibious operations using their attack helicopters and the long-range surface-to-surface missiles in VLS magazines. With a VLS magazine, small-deck amphibious ships would also be able to employ medium-range air defense interceptors such as ESSM to improve their staying power in a contested area.

American naval posture in the Black Sea is affected by its geographic constraints, the ability of Russian forces to surveil and engage U.S. platforms from their base in Sevastopol, and the Montreux Convention's restrictions on the entry of outside navies.⁵⁹ The proposed fleet architecture addresses these constraints by forward stationing an Unmanned Vehicle Squadron

The Unmanned Vehicle Squadron would consist of an unmanned vehicle support vessel with several CUSVs, MALE UAVs, three to six XLUSVs, and three to six XLUUVs to support ASW, counter-ISR, mining, mine clearing, and SUW operations. Initially, unmanned vehicle support vessels would be EPFs or ESBs. These would be replaced at their end of service life with purpose-built aviation-capable unmanned vehicle tenders.

split between Turkey and Romania to support Offensive Mining and Counter-ISR Groups that can hold at risk Russian sensors and naval forces in Crimea. An unmanned vehicle support vessel would periodically tend to these vehicles, while standing by to support ASW operations in the eastern Mediterranean as well.

West Africa will be an “economy of force” region. A Crisis Response Group, typically assigned from the

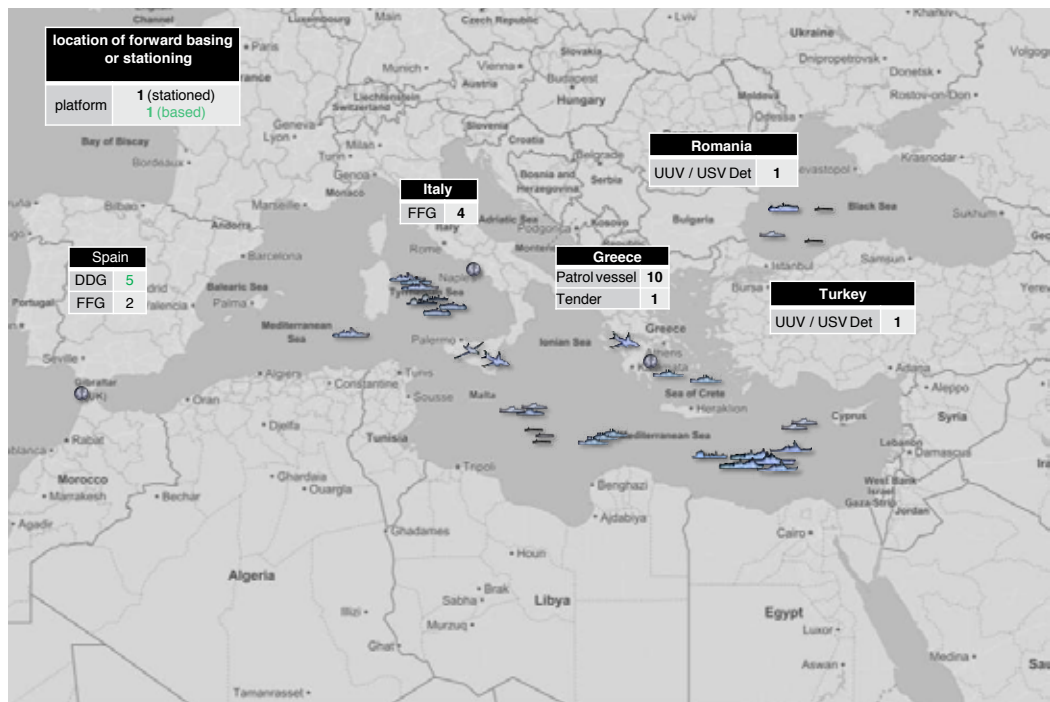
⁵⁹ The Montreux Convention limits the total tonnage of non-Black Sea navies in the Black Sea to less than 30,000 tons. For example, only two U.S. DDGs or one small-deck amphibious ship could be deployed in the Black Sea at a time. See Bulent Gokcicek, *The Montreux Convention Regarding the Turkish Straits and Its Importance After the South Ossetia War*, master's thesis (Monterey, CA: Naval Postgraduate School, 2008), available at <http://www.dtic.mil/dtic/tr/fulltext/u2/a496759.pdf>.

Mediterranean Deterrence Force, will operate in the region for peacetime Noncombatant Evacuation Operations (NEO), crisis response, or maritime security operations.

Forward basing in and around the Mediterranean Sea, depicted in Figure 23, would include FFGs forward-stationed in Italy and Spain and a patrol vessel squadron and tender forward-stationed in Greece. Unmanned vehicle detachments capable of EW, ISR, and offensive mining would operate from NATO Black Sea ports.

The Crisis Response Group would consist of a frigate and a small-deck amphibious ship with rotary wing logistics and attack aircraft, ship-to-shore connectors, and MALE UAVs for ISR and communications. Typically, these forces would be prepared to detach quickly from their primary theater of interest to operate independently. Primarily devoted to humanitarian assistance and small-scale crisis response, these detached formations would require logistical support from within the Deterrence Force and/or from local provisioning ports.

FIGURE 23: MEDITERRANEAN SEA BASING



Western Indian Ocean and Persian Gulf Deterrence Force

These forces would operate primarily in the Persian Gulf, the Gulf of Aden, the Gulf of Oman, the North Arabian Sea, the Red Sea, and the waters off the Horn of Africa and East Africa. Their main objective would be to deter Iran and its proxies from aggression by demonstrating the ability to deny them their objectives and punish aggression. Secondarily, this force would be designed to deter China and Russia.

Deterring Iran requires a naval force that is capable of denying or delaying Iranian attempts to mine the Strait of Hormuz; conduct SUW operations with ships, aircraft, and submarines; or mount amphibious raids against neighboring states. Although the focus of this force would be on Iran and ensuring U.S. allies in Europe and the Indo–Asia–Pacific region maintain access to energy and trade, it would also need to be prepared to threaten Chinese and Russian naval forces and their access to resources from the region as part of a global response to punish aggression.

The Mine Countermeasures Group would combine an aviation-capable unmanned vehicle support ship with three to six Common USVs towing minehunting sonars, two or more XLUSVs to tow minesweeping gear and deploy mine neutralization micro UUVs, and two or more MALE UAVs to find shallow mines with laser and EO/IR sensors.

U.S. forces in the Persian Gulf, shown in Table 5, would include Littoral Combat Groups to support SUW and strike, as well as Mining Groups to deny access to Iranian ports or attack Iranian naval forces. These force packages would include two patrol vessels contributed by U.S. allies in the region. Working with regional and possibly NATO allies, a Mine Countermeasures

Group in the region would stand by to clear mines quickly in order to deny Iran the benefits of offensive mining. Because of the proximity and vulnerability of Bahrain to Iranian attack, a command ship similar to today's LCC operating in the region would provide a resilient and mobile facility for planning, coordinating with allies and partners, and C2 of forces.

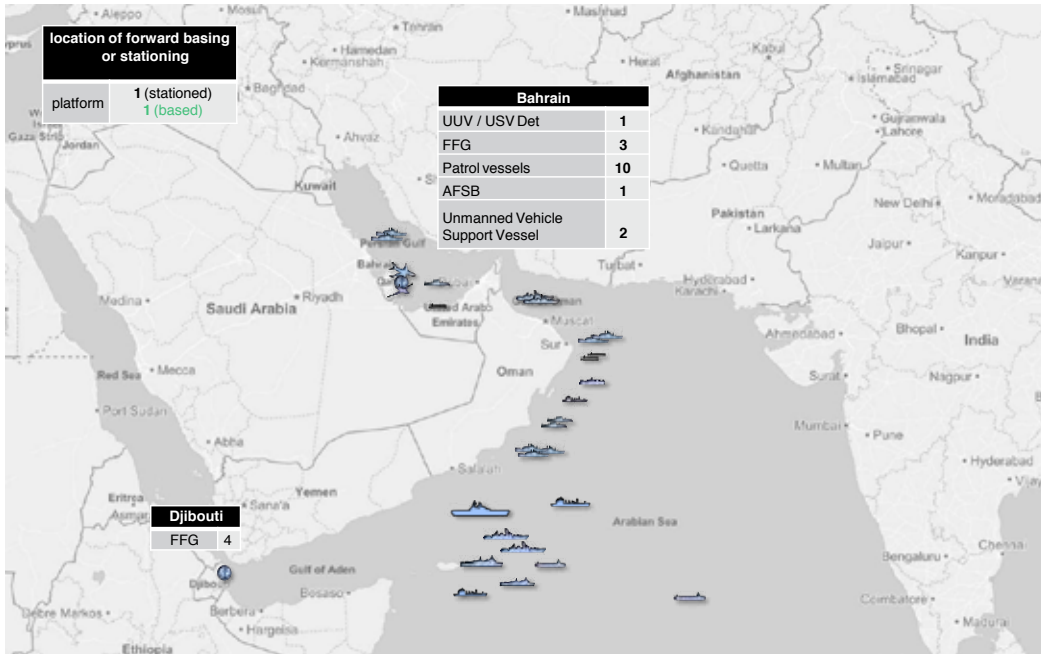
TABLE 5: WESTERN INDIAN OCEAN AND PERSIAN GULF DETERRENCE FORCE COMPOSITION

Western Indian Ocean		Persian Gulf	
Ship	Operational Presence	Ship	Operational Presence
CVL	1.2	FFG	1.7
FFG	2.3	Patrol Vessel	7.0
SSN	1.0	XLUSV	2.6
Small Deck Amphibious Ship	2.4	XLUUV	2.6
Large Multi-Product Logistics Ships (AOE) (MSC)	1.7	Small Deck Amphibious Ship	1.2
		Large Multi-Product Logistics Ships (AOE) (MSC)	1.0
		Unmanned Vehicle Support Vessel (MSC)	2.0
		Afloat Forward Staging Base (MSC)	1.0
		Tender (MSC)	1.0
		Salvage / Fleet Tug (MSC)	1.0
		Command Ship (MSC)	1.0
		MQ-4 Detachment	1.0
		P-8 Detachment	1.0

Outside of the Persian Gulf—in the Gulf of Oman, the Gulf of Aden, East Africa, and the North Arabian Sea—a 4-ship ARG and a SAG would be able to conduct SUW and strike warfare against Iranian, Chinese, or Russian forces. In peacetime, these forces would work with allied and partner navies and be used for counter-terrorism and maritime security operations such as strikes against terrorists in Yemen or Somalia and counter-piracy patrols in the Gulf of Aden.

Basing initiatives in this region, depicted in Figure 24, would include four FFGs forward-stationed in Djibouti and three FFGs forward-stationed in Bahrain. A patrol vessel squadron, afloat forward staging base, and unmanned vehicle support vessel would be forward-stationed in Bahrain.

FIGURE 24: MIDDLE EAST BASING



Indian Ocean Deterrence Force

The objective of this small, far-ranging Deterrence Force in great power competition would be to attack adversary naval forces and interests to punish aggression. The Indian Ocean Deterrence Force would consist of a continuous presence of one or two SSNs and Diego Garcia-based high-altitude long endurance (HALE) UAVs. In peacetime, the Indian Ocean Deterrence Force would monitor adversary naval forces and support ongoing counter-terrorism and maritime security operations.

East China Sea and South China Sea Deterrence Force

The Deterrence Forces arrayed in the South and East China Seas would be designed to deny or delay Chinese aggression against likely objectives such as Taiwan, the Senkaku Islands, or the Spratly Islands by eliminating Chinese naval forces and advanced bases in the region. They would also be capable of punishing aggression by attacking Chinese targets from inside the first island chain.

As shown in Table 6, the South and East China Sea forces would be built around multi-mission SAGs, ASW Groups, and Mining Groups supported by unmanned vehicle squadrons and support vessels.⁶⁰ The South China Sea Deterrence Force would also include Littoral Combat Groups to provide additional SUW and strike capacity close to shore and offer smaller force packages that enable commanders to proportionally address provocations and better manage escalation.

60 The ASW Group in the East China Sea does not include a T-AGOS ship due to the shallow water there.

These forces would be more widely dispersed than current forces in the region and would bring a larger number of offensive weapons to bear from more directions; this will help these platforms to engage targets quickly using fleeting data. As in the Mediterranean and Persian Gulf, surface combatants in the South China Sea would be able to protect themselves with high-capacity medium-range air defenses long enough to expend their offensive SUW and strike weapons before they withdraw to the periphery of the theater.

The need to train, coordinate, or execute combined operations with U.S. allies and partners is critical in the Indo–Asia–Pacific region. Similarly, these nations possess highly professional and modernized navies and air forces, key niche capabilities, and indispensable local knowledge. In the case of the South and East China Seas, U.S. allies would, for example, be expected to contribute ASW, SUW, ISR, and counter-ISR capabilities as well as those needed to maintain access through critical chokepoints.

TABLE 6: SOUTH AND EAST CHINA SEA DETERRENCE FORCE COMPOSITION

South China Sea		East China Sea	
Ship	Operational Presence	Ship	Operational Presence
DDG	2.6	Very Large Surface Combatant (DDG-1000)	1.5
FFG	3.4	DDG	3.5 (+1 Allied)
Patrol Vessel	5.0	FFG	3.4 (+2 Allied)
XLUSV	5.1	XLUSV	2.6
SSN	2.1	SSN	2.2
XLUUV	5.1	XLUUV	2.6
Small Deck Amphibious Ship	1.5	Small Deck Amphibious Ship	1.5
Large Multi-Product Logistics Ships (AOE) (MSC)	3.0	Large Multi-Product Logistics Ships (AOE) (MSC)	4.2
Unmanned Vehicle Support Vessel (MSC)	2.0	Unmanned Vehicle Support Vessel (MSC)	2.0
Unmanned Vehicle Squadron	1.0	Unmanned Vehicle Squadron	1.0
Afloat Forward Staging Base (MSC)	1.0	Tender (MSC)	1.0
Tender (MSC)	1.0	MQ-4 Detachment	1.0
Oceanographic Research Ship (T-AGOS) (MSC)	2.0	P-8 Detachment	1.0
MQ-4 Detachment	1.0		
P-8 Detachment	2.0		

The small deck amphibious ships of an ARG would be postured across the South and East China Seas to conduct distributed amphibious operations as described in Chapter 3 throughout the Southwest Islands of Japan, the Philippines, and elsewhere around the South China Sea. This would further increase the forces' capacity and diversity of surface-to-surface fires, helping to make the first island chain a barrier to Chinese power projection rather than a potential jumping off point for it.⁶¹

Amphibious ships and DDGs in the East China Sea would also stand by to counter aggression by North Korea. The most significant threat from North Korea, particularly early in the conflict, would be maritime special operations forces (SOF). To engage the small boats and submarines used by SOF, the East China Sea Deterrence Force would include ASW Groups and SAGs, led by a very large surface combatant (DDG-1000) for C2 and littoral fires.

Western Pacific and Philippine Sea Deterrence Force

The Deterrence Force outside the first island chain in the Western Pacific would be closely tied to those in the South and East China Seas, but its role would be focused on attacking Chinese naval forces in the open ocean and conducting long-range strikes against Chinese forces and other targets in the South and East China Seas. U.S. allies would be expected to contribute ASW, SUW, ISR, and counter-ISR capabilities, particularly to ensure access through critical chokepoints, as well as land-based strike and AAW capabilities.

The Deterrence Force in the Philippine Sea and Western Pacific, shown in Table 7, would be centered on the CVL (or LHA/LHD) from the ARG associated with the small-deck amphibious ships inside the first island chain. CVL strike-fighters would conduct strike, SUW, and ISR operations to help deny Chinese aggression inside the South and East China Seas or attack Chinese naval and other targets outside the first island chain. As in the North Atlantic, it is to be expected that the CVL would be targeted and attacked by China's reconnaissance-strike complex in time of war, so this Deterrence Force would include DDGs to protect the CVL and a modified Counter-ISR Group to reduce the effectiveness of Chinese targeting.⁶²

To address Chinese naval forces outside the first island chain, the Western Pacific Deterrence Force would include an ASW Group and SSNs to conduct track-and-trail operations akin to those in the Northern Atlantic and described in Chapter 3. In wartime, U.S. SSNs would shift to focus on strikes and SUW while Chinese submarines would be attacked by additional P-8s flying from bases in Japan and the Philippines.

Strike warfare against Chinese aggression would be supported by a large logistics ship equipped with a VLS magazine and capabilities to reload other ships' VLS cells, such as

61 The "first island chain" refers to the first set of island nations that separate China from the Pacific Ocean. They include Japan, Taiwan, the Philippines, Indonesia, and Malaysia.

62 The Western Pacific Counter-ISR Group will include a DDG to provide C2 instead of an FFG to provide additional air defense capacity for the CVL.

the strike-down crane that was previously installed on CGs and DDGs.⁶³ This would enable reloading of Deterrence Force surface combatants in low sea states around the littorals of the first island chain.

TABLE 7: WESTERN PACIFIC/PHILIPPINE SEA DETERRENCE FORCE COMPOSITION

Western Pacific and Philippine Sea	
Ships	Operational Presence
CVL	1.0
DDG	3.0
XLUSV	2.6
SSN	3.1
XLUUV	2.6
Large Multi-Product Logistics Ship (AOE) (MSC)	5.0
Unmanned Vehicle Support Vessel (MSC)	1.0
Large Multi-Product Logistics Ship w/VLS (MSC)	1.0
Tender (MSC)	1.0
Salvage / Fleet Tug (MSC)	2.0
Oceanographic Research Ship (T-AGOS) (MSC)	2.0
Command Ship (MSC)	1.0
MQ-4 Detachment	1.0
P-8 Detachment	2.0

Basing changes to support the fleet architecture's posture should be considered together for the three East Asian regions and are depicted in Figure 25. In addition to DDGs and SSNs from CONUS, this posture relies on forward-based and forward-stationed forces throughout the first island chain and Guam, with the preponderance operating out of Japan. The proposed fleet architecture would add to the U.S. Navy's forces currently based in Japan: a second forward-based ARG and two more forward-stationed FFGs in Sasebo, another forward-based DDG in Yokosuka, and a forward-stationed tender to address additional maintenance requirements throughout Japan.

Notably, the CVN currently based in Japan would remain there in the new fleet architecture, even though it will be part of the Maneuver Force. The rest of the Maneuver Force is based at

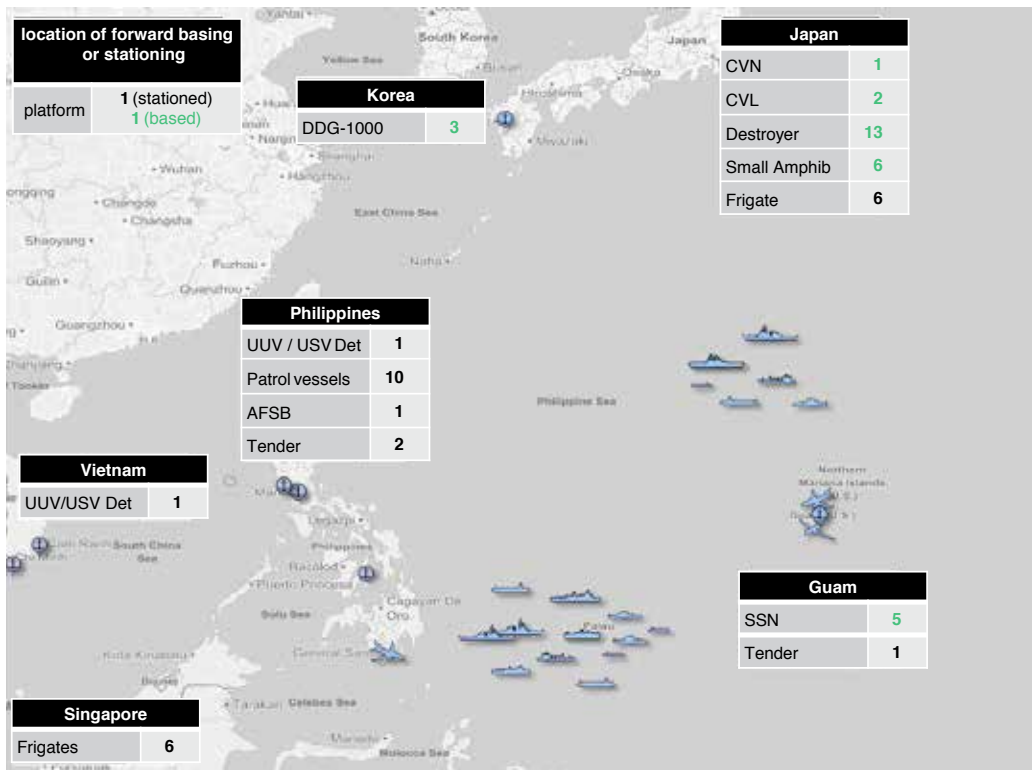
63 The strike-down crane took the place of three VLS cells and was challenging for a combat ship to maintain and operate. These disadvantages would not be as significant on a logistics ship designed for weapons and dry stores resupply and support operations. See Nick Myhre, "VLS At-Sea Reloading" *USNI blog*, July 30, 2015, available at <https://blog.usni.org/2015/07/30/vls-at-sea-reloading>.

Fleet Concentration Areas on the West Coast of CONUS. The CVN is maintained in Japan to reassure Japan of American resolve and provide a means of quickly augmenting the Maneuver Force when the Japan CVN is in the sustainment phase of its readiness cycle, as will be discussed in Chapter 9.

Complementing U.S. naval forces in Japan, the proposed fleet architecture would forward-station a patrol vessel squadron, an Afloat Forward Staging Base (AFSB), and tender in the Philippines to support littoral SUW, strike, SOF, and maritime security operations. It would also add two forward-stationed FFGs to the planned four in Singapore and an additional forward-based SSN in Guam for a total of five. To support C2 for forces in the East China Sea and provide littoral fires against North Korea, three very large surface combatants (DDG-1000) would be forward-based in the Republic of Korea.

Some of these basing changes are already being considered by U.S. and host nation leaders. If they are unable to come to fruition, the impact would be reduced numbers of platforms deployed in the region, since they will have to travel there from another region. For example, if a patrol vessel squadron and associated tender could not be stationed in the Philippines, it could operate in Indonesia, the Southwest Islands of Japan, or Singapore.

FIGURE 25: EAST ASIA BASING



Arctic Deterrence Force

By the 2030s, the Arctic may be a contested region. The Arctic is of increasing strategic importance to great powers Russia and China as well as America's NATO allies and other European partners. The Arctic promises to be the scene of increasing tensions that accompany a growing competition for energy, mineral, and sea-based protein resources as the Arctic ice recedes more each summer. The growing duration and scope of ice-free periods also creates more opportunities to use the Arctic as a commercial shipping route, which will increase demands for maritime security and search and rescue operations.

This fleet architecture would sustain submarine operations in the Arctic to support ASW against Russian submarines. Further, to create a visible U.S. presence in the Arctic and work with allies, in warmer months the proposed fleet architecture would sustain an ice-capable FFG and an unmanned vehicle support vessel to host MALE UAVs for ISR and search and rescue.

TABLE 8: ARCTIC DETERRENCE FORCE

Arctic Ocean	
Ships	Operational Presence
SSN	0.9
MQ-4 detachment	1.0
FFG	0.3
unmanned vehicle support vessel	0.3

Maneuver Force

The Maneuver Force (Table 9), as described in Chapter 4, would be a multi-carrier task group capable of waging modern cross-domain war at and from the sea. A fundamental difference between the Deterrence Force and the Maneuver Force would be the type of combat power each force could generate. The Deterrence Force could conduct high-capacity missile-centric strike, SUW, and ASW operations on short notice, but could only sustain them for a limited time before its ships would have to reload their magazines. The Maneuver Force would be optimized to sustain combat power over a much longer time than the Deterrence Force, but could generate less combat power in any given period of time, depending on the degree to which enemy attacks suppress carrier operations.

This fleet architecture would best employ the advantages of each force by using a missile-centric Deterrence Force as the front line against aggression and the Maneuver Force as reinforcements that would join the Deterrence Force to continue combat operations at a high tempo when the Deterrence Force becomes exhausted and withdraws. The Maneuver Force would then be augmented by the Joint Force, both from forward bases and CONUS.

The Maneuver Force would be built around two CSGs with air wings adapted to conduct long-range operations in contested environments, alone and in support of Joint Force efforts, as described in Chapter 7. The Maneuver Force would include SSNs to conduct strike, SUW, and ASW operations. Because it will normally operate outside the littoral regions addressed by the Deterrence Forces, the main threats to the Maneuver Force are submarines and long-range missile attacks. To address these challenges, the Maneuver Force includes an Unmanned Vehicle Squadron with an unmanned vehicle support vessel to bolster Counter-ISR and ASW Groups. Elements of the Maritime Pre-positioning Force would also be attached to the Maneuver Force to support large-scale amphibious operations by resupplying and augmenting the amphibious forces in the affected region's Deterrence Force.

The Maneuver Force would be based in CONUS, except for MSC ships which may operate from Pacific ports outside of CONUS and the CVN forward-based in Japan. The Maneuver Force would be part of the deployed force, just as CSGs are today. It would participate in exercises, particularly with allies and partners; port calls; etc.—as legacy CSGs do. It would remain under the operational control (OPCON) of the PACOM commander, who can move it, as appropriate, to signal resolve, deter conflict, and be in position to reinforce Deterrence Forces when conflict becomes likely.

TABLE 9: MANEUVER FORCE COMPOSITION

Maneuver Force	
Ships	Operational Presence
CVN	2.0
DDG	6.0
FFG	7.0
XLUSV	3.0
SSN	4.0
XLUUV	3.0
Large Multi-Product Logistics Ships (AOE) (MSC)	4.0
Large Multi-Product Logistics Ship (AKE) (MSC)	2.0
Unmanned Vehicle Support Vessel (MSC)	2.0
Salvage / Fleet Tug (MSC)	1.0
MPS Squadron	1.0

Logistics and Support Forces

Logistics and support forces are a critical component of a globally distributed Navy. Sustained, high-end conflict can only be conducted if sufficient logistical support is available. In wartime, a CVN can exhaust its fuel and ammunition stores in a matter of days, and surface combatants or submarines could expend their munitions in a matter of minutes. Moreover, after decades of uncontested movement at sea and operations within easy reach of friendly resupply ports, logistics operations will likely be heavily contested in future conflicts.

To address these challenges, the proposed fleet architecture identifies new operating concepts and capabilities to provide logistics support to Deterrence and Maneuver Forces. These new approaches prioritize wartime effectiveness over peacetime efficiency and correct some of the imbalances in the current CLF ship mix.

Today, CLF fleet replenishment oilers (T-AO) and dry cargo/ammunition ships (T-AKE) shuttle between deployed forces at sea and the closest port that can support refueling and resupply operations. Because warships carry most of their required dry stores and weapons with them on deployment and can replenish parts and food during port calls, the main CLF demand is for replenishment at sea (RAS). A T-AO can carry about five times the fuel of a T-AKE, making it a more efficient RAS platform. The CLF fleet, however, includes almost as many T-AKEs as T-AOs. This results in more frequent use of T-AOs than T-AKEs and underutilization of T-AKEs. Moreover, ports that supply specialized military fuels are sometimes distant from deployed force operating areas. As a result, T-AOs and T-AKEs often spend much of their time in transit, reducing their efficiency.

The proposed fleet architecture's logistics concept is depicted in Figure 26. The CLF will be rebalanced toward large multi-product logistics ships such as fast combat support ships (T-AOE), which will support fuel and ammunition needs of the deployed force. T-AKEs would normally operate only with the Maneuver Force, where they carry about half the CSG ordnance supply.

During peacetime, T-AOEs would operate forward with the Deterrence Force, and both T-AOEs and T-AKEs would operate with the Maneuver Force. In wartime, T-AOEs would refuel and reload from consolidated refueling (CONSOL) tankers (T-AOT) and geared container ships (T-AK) prepositioned in peacetime to reduce the transit time for CLF ships. T-AOTs and T-AKs, in turn, will periodically refuel and rearm at an appropriate port. Given the large quantity of supplies and ammunition carried on T-AKEs, it is expected that expeditionary logistics transfers from T-AKs would, in general, not be possible, and T-AKEs would be required to reload at more distant major ports.

FIGURE 26: DETERRENCE FORCE LOGISTICS OPERATIONS

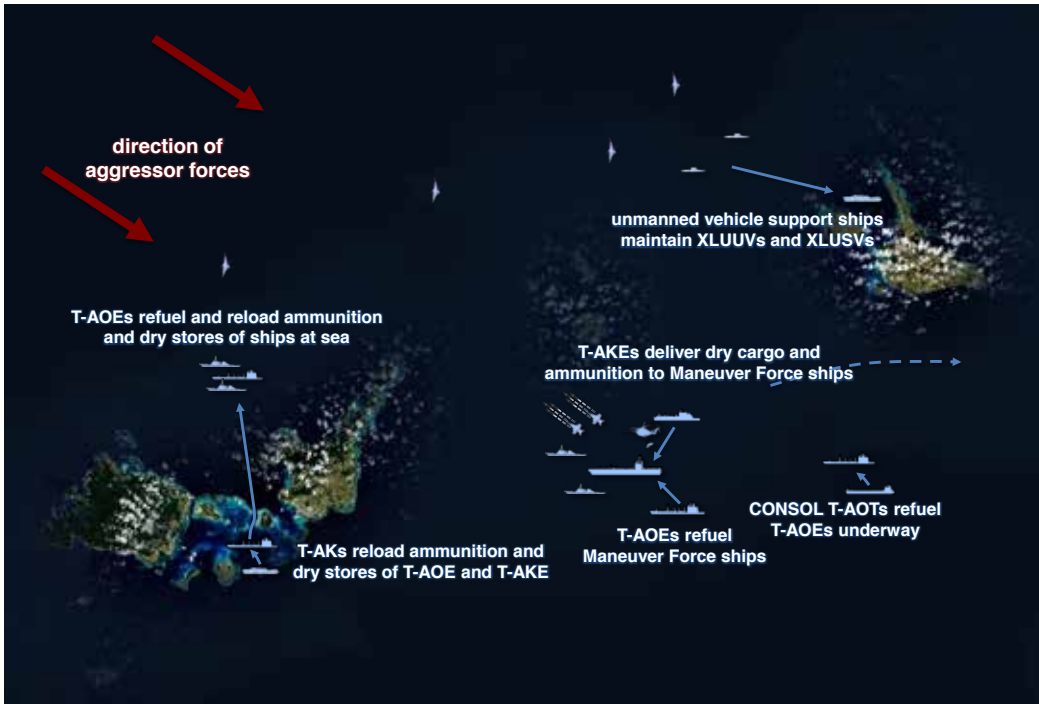
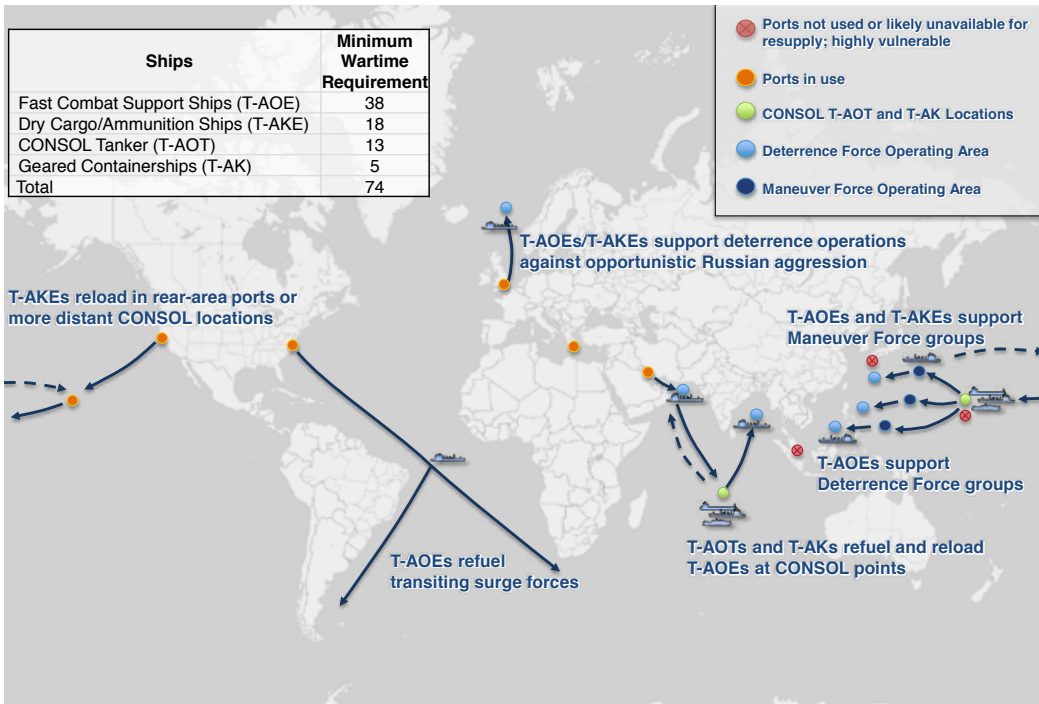


FIGURE 27: WARTIME LOGISTICS FORCE POSTURE



The CLF is one of the combat fleet elements for which a rotation base cannot be used to support wartime surge. CLF ships are rotationally manned by civilian mariners and do not have a readiness cycle like other naval forces. To achieve a wartime surge, additional T-AOEs, T-AKEs, T-AOTs, and T-AKs would be activated to support large-scale high-tempo operations of Deterrence and Maneuver Forces. The CLF posture that results from global application of the logistics concept above in a great power conflict is depicted in Figure 27.

The wartime CLF requirement to execute an Indo–Asia–Pacific war against China using East Asian Deterrence and Maneuver Forces while maintaining European Deterrence Force operations against Russia is shown in Table 10. This analysis is discussed in Appendix B.

TABLE 10: COMPARISON OF CLF MINIMUM WARTIME AND PEACETIME REQUIREMENTS

Ships	Wartime Requirement	Peacetime Requirement	Difference
Combat Support (T-AOE)	38	26	12
Dry Cargo/Ammunition (T-AKE)	18	4	14
CONSOL Tanker (T-AOT)	13	4	9
Geared Containerships (T-AK)	5	2	3

The significant difference between the wartime and peacetime CLF requirements could lead to arrangements in which portions of the wartime T-AOE and T-AKE fleets were placed into the Maritime Administration’s Ready Reserve Force with a Reduced Operating Status of 10 days of activation.⁶⁴ This would decrease the peacetime operating cost of the CLF. Similarly, some T-AOTs not needed in peacetime could be leased to industry for commercial trade, or the T-AOTs could be secured through the Merchant Ship Naval Augmentation Program/Volunteer Tanker Program and only chartered in time of war.⁶⁵

64 A portion of the peacetime excess T-AOE fleet could also be leased to industry for commercial fuel product trade. However, the relatively small size of these ships’ fuel capacities (156,000 bbl.) compared to commercial tanker alternatives may decrease the economic appeal of these ships to industry absent significant subsidies.

65 Given the small size of the T-AK force and the lengthy delay involved in loading large quantities of ammunition, commercial arrangements for this portion of the force would likely be impractical.

CHAPTER 6

New Ships, Unmanned Vehicles, Weapons, Sensors, and Mission Systems

The force packages and operational concepts of the proposed fleet architecture require new or modified platforms, weapons, and sensors. They also rely to a much greater degree than today's force on unmanned vehicles to expand the reach and endurance of manned ships and aircraft. New or modified ships and associated unmanned surface and undersea vehicles of the new fleet architecture are described below. New aircraft will be described in Chapter 7.

This new architecture, however, must emerge from today's fleet and be achievable within the constraints of the industrial base and realistic future budgets. The discussion of readiness cycles in Chapter 8 will include implications of the proposed fleet architecture for the ship maintenance industrial base. Chapter 9 will describe the shipbuilding plan, including costs, that will deliver the new fleet architecture by the 2030s within the constraints of the industrial base. Chapter 9 will also address the likely O&M costs associated with the new architecture.

Aircraft Carriers

The Navy plans to maintain a fleet of eleven nuclear-powered *Nimitz*-class and *Gerald R. Ford*-class aircraft carriers, with the latter replacing the former over the next 50 years.⁶⁶ These 100,000-ton platforms provide a mobile airfield for a CVW of up to ninety aircraft, the make-up of which can adapt to the intended operations and evolve over time to address a changing threat environment. The proposed fleet architecture accelerates CVN production to increase the force to twelve CVNs.

66 CNO, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2017*, p. 5.

By the 2030s, CVWs will need to evolve to increase their organic logistics and refueling capability, extend their strike range, reassert the air wing's role in sea control missions such as ASW and anti-surface warfare (ASUW), and perform organic scouting and ISR functions. The nature of these changes and their implications for specific aircraft in the CVW are described in detail in Chapter 7.

FIGURE 28: CVN-78 USS GERALD R. FORD



U.S. Navy Concept Graphic

The proposed fleet architecture adds to today's CVNs smaller conventionally powered CVLs of 40,000 to 60,000 tons that would be incorporated into ARGs as part of the Deterrence Force. CVLs would provide power projection and sea control capabilities at the scale needed for day-to-day operations and for SUW, strike, and CAS as part of initial combat, freeing CVNs to focus on high-end integrated multi-carrier operations as part of the Maneuver Force or the Northern Europe Deterrence Force.

In the near-term, existing LHA/LHD amphibious assault ships would be employed as CVLs using a loadout of twenty to twenty-five F-35B aircraft.⁶⁷ As they reach the end of their service life, LHA/LHD-derived CVLs would be replaced by purpose-built CVLs with a displacement similar to a Cold War-era *Midway*-class aircraft carrier and equipped with catapults and arresting gear.⁶⁸ As a result, CVL air wings would be able to become slightly larger and incor-

67 Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (AT&L), *Selected Acquisition Report as of December 31, 2012: LHA 6 America Class Amphibious Assault Ship (LHA 6)* (Washington, DC: DoD, December 31, 2012), p. 9, available at http://www.dod.mil/pubs/foi/Reading_Room/Selected_Acquisition_Reports/LHA_6_December_2012_SAR.pdf.

68 USS *Midway*'s empty displacement was about 45,000 tons on commissioning; at decommissioning, its displacement was about 65,000 tons due to modifications made over its life.

porate airborne electronic attack (AEA) and airborne early warning (AEW) aircraft that are catapult-launched and require an arrested landing.

FIGURE 29: CV-41 USS MIDWAY



U.S. Navy Photo

Submarines

Nuclear submarines will remain the centerpiece of America's undersea fleet in the proposed fleet architecture, which would accelerate SSN construction to eventually reach sixty-six SSNs. In Deterrence Forces, *Seawolf* and Block I–IV *Virginia*-class submarines would be used primarily for ASW and SUW and secondarily to conduct strikes on targets ashore. These SSNs do not have the larger strike or UUV capacity of the Block V *Virginia*-class SSN with the Virginia Payload Module (VPM).⁶⁹ VPM-equipped SSNs would be used mostly in the Maneuver Force, where their payload capacity can be best exploited to support sustained strike warfare in what will be a highly contested environment by the time the Deterrence Force expends its munitions and withdraws.

⁶⁹ VPM-equipped SSNs carry up to forty vertically launched missiles, compared to twelve–fourteen for other SSNs. See Karl Hasslinger and John Pavlos, "The Virginia Payload Module: A Revolutionary Concept for Attack Submarines," *Undersea Warfare Magazine*, no. 47, Winter 2012, available at http://www.public.navy.mil/subfor/underseawarfaremagazine/issues/archives/issue_47/virginia.html.

SSNs would become less critical over time for strike missions as more strike capacity shifts in the proposed fleet architecture to surface combatants, CVLs, an improved Maneuver Force CVW, and UUVs. Therefore, the new fleet architecture only equips half the Block V *Virginia*-class SSNs with VPM. This also provides more industrial base capacity to build four SSNs per year after the *Columbia*-class SSBNs are constructed.

The proposed fleet architecture does not suggest any changes to the Navy's planned fleet of twelve SSBNs.

Unmanned Underwater Vehicles

The proposed fleet architecture uses a family of UUVs to implement the new operational concepts described in Chapter 3. Each of these vehicles is in development, but their exact capabilities are not yet fully established. In general, their characteristics are defined largely by their diameter and displacement, since their size constrains how they can be deployed, the amount of payload they can carry, their speed, and their endurance. The family of UUVs used in the architecture includes:

FIGURE 30: BOEING ECHO VOYAGER XLUUV



Photo courtesy of Boeing Company

- *Extra-Large Displacement UUVs* over 80 inches in diameter and with lengths of 30 feet or more can conduct undersea surveillance using hull-mounted and towed sonar arrays and deploy UUVs, UAVs, mines, and other weapons. XLUUVs such the Boeing Echo Voyager are powered by batteries that can be recharged by snorkeling with an onboard

diesel generator. Their range can be more than 1500 nm and their endurance greater than 6 months.⁷⁰

FIGURE 31: GLIDER UNMANNED VEHICLE

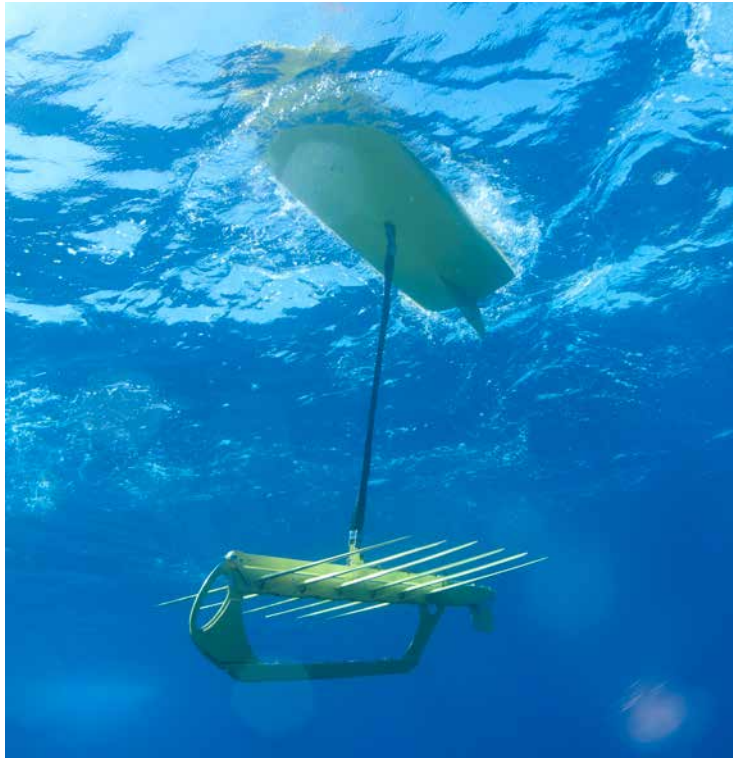


Photo courtesy of Liquid Robotics, Inc

- *Glider unmanned vehicles* more than 20 ft. in length can be used for long-duration undersea surveillance. For propulsion, these vehicles use wave action and small electric motors recharged by solar panels. Gliders have a small surface expression, allowing them to use RF communications. Their power and propulsion sources enable gliders to patrol until they require maintenance or cleaning, which is about every 6 months. Gliders can carry low-power passive sensors such as towed sonar arrays or SIGINT equipment.⁷¹
- *Large Displacement UUVs (LDUUV)* of 21–80 inches in diameter with lengths of 20–30 ft. can conduct surveillance and deploy payloads like the XLUUV, but with less payload and with about 30 to 60 days of endurance. Their smaller size relative to XLUUVs

⁷⁰ Alex Davies, “Boeing’s Monstrous Underwater Robot Can Wander the Ocean for 6 Months,” *Wired*, March 21, 2016, available at <https://www.wired.com/2016/03/boeings-monstrous-underwater-robot-can-wander-ocean-6-months/>.

⁷¹ Geoff Fein, “Northrop Grumman Conducts Advanced Unmanned Systems Teaming,” *IHS Jane’s International Defence Review*, September 5, 2016, available at <http://www.janes.com/article/63436/northrop-grumman-conducts-advanced-unmanned-systems-teaming>.

enables LDUUVs to be deployed by another platform closer to the objective area to reduce the LDUUV's vulnerability or enable more rapid deployment. LDUUVs can be deployed by a ship or from shore; they can also be carried in a VPM tube in place of seven 21-inch missiles such as Tomahawks.⁷²

- *Medium Displacement UUVs (MDUUV)* are approximately 21 inches in diameter, the size of a submarine-launched Mk-48 torpedo. They can be used for surveillance with a towed passive sonar array or an integrated active HF sonar and can be used as a weapon either for short-range, high-speed attacks or long-range, lower-speed attacks. Depending on the power supply, MDUUVs could have ranges of up to 1000 nm.⁷³
- *Small Displacement UUVs (SDUUV)* of 12–21 inches in diameter, such as the Navy Mk-18 or Hydroid Remus 600 UUV, are used for oceanographic survey and monitoring and could carry weapons payloads. Depending on their power supply, their range could be up to 800 nm.⁷⁴
- *Micro UUVs* are less than 6 inches in diameter and are intended to be used in groups for operations such as infrastructure attack, decoying and jamming sonars, or surveying. Micro UUVs are about the same size as sonobuoys, which are increasingly becoming like micro UUVs. They have a range of up to 500 nm and can operate at low power for about 300 hrs.⁷⁵

FIGURE 32: RIPTIDE MICRO UUV



Photo courtesy of Riptide Autonomous Solutions, LLC

72 Office of Naval Research, “Large Displacement Unmanned Underwater Vehicle Innovative Naval Prototype (LDUUV INP) Energy Section Technology,” Broad Agency Announcement, August 4, 2011, available at <http://www.onr.navy.mil/~media/Files/Funding-Announcements/BAA/2011/11-028.ashx>.

73 David Duryea and Donald McCormack, “Sustaining Undersea Dominance To Ensure Future (2025) Joint Operational Access,” *NDIA Undersea Warfare Division Newsletter*, no. 36, Fall 2014, available at <http://www.ndia.org/Divisions/Divisions/UnderseaWarfare/Documents/newsletter%20-%20fall%202014.pdf>.

74 Kongsberg Maritime, “Autonomous Underwater Vehicle—REMUS 600,” fact sheet, available at <https://www.km.kongsberg.com/ks/web/nokbgo240.nsf/AllWeb/FO437252E45256BDC12574AD004BDD4A?OpenDocument#tab-3>. See also Open Water Power, “Oil & Gas Operations in the Gulf of Mexico,” map graphic, available at <http://openwaterpower.com/>.

75 Riptide Autonomous Solutions, “Micro-UUV,” factsheet, available at <https://riptideas.com/micro-uuv/>.

Surface Combatants

The proposed fleet architecture rebalances the surface combatant fleet toward larger numbers of smaller surface combatants to support operational concepts for high-volume, distributed SUW and strike in the Deterrence Force. These concepts will require that surface combatants be able to defend themselves from air and missile threats well enough to expend their offensive weapons. To that end, each surface combatant would be equipped with multi-mission SUW/strike missiles in VLS or deck-mounted box launchers and at least two compact rolling airframe missile (C-RAM) launchers for air defense. To conduct targeting and support line-of-sight communications, surface combatants would carry at least two MALE UAVs, such as DARPA's TERN UAV, and one conventional helicopter as described in Chapter 7.

FIGURE 33: LCS-1 USS FREEDOM



U.S. Navy Photo

Large surface combatants (DDG and CG). Consistent with the Navy's current plans, the proposed fleet architecture does not include a follow-on CG to replace today's *Ticonderoga*-class CGs. The proposed architecture requires seventy-one large surface combatants, which can be provided by DDG-51s, and therefore does not incorporate the phased modernization of CGs to extend their lives into the 2030s. Flight III *Arleigh Burke*-class DDGs (DDG-51) will replace CGs and Flight I DDG-51s. By 2030, DDG-51 variants will be the only large surface combatants in the proposed architecture. Of note, the proposed architecture will build DDGs to maintain only seventy-one large surface combatants compared to the Navy's current objective of 104.⁷⁶

⁷⁶ CNO, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2017*, p. 5.

Today large surface combatants are equipped primarily to provide wide area air defense for CSGs or BMD for regions ashore. In the proposed fleet architecture, only large surface combatants associated with the Northern Atlantic Deterrence Force and the Maneuver Force would conduct wide area layered air defense. The rest of the large surface combatant fleet would focus on medium-range area air defense to protect non-combatant ships under escort or other ships in a SAG. BMD missions would increasingly shift to shore-based systems such as Aegis Ashore.

FIGURE 34: EGYPT'S AMBASSADOR-CLASS FAST MISSILE CRAFT (POTENTIAL FUTURE U.S. PATROL VESSEL)



Ahmed XIV via Wikimedia Commons

Small surface combatants. Today, the Navy is building toward a small surface combatant fleet of twenty-eight to twenty-nine LCSs and eleven to twelve fast frigates (FF), for a total of forty.⁷⁷ The FF hull will be based on one of the two 3100-ton LCS variants currently in production. The LCS class uses mission packages to conduct either ASW, MCM, or SUW, which can be changed out periodically over the life of the ship to address changing mission requirements. The FF will permanently carry the ASW mission package and portions of the SUW mission package, including the additional personnel needed for these systems. The Navy also plans to upgrade the FF and some LCSs with the passive SEWIP Block 2 EW suite, over-the-horizon surface-to-surface missiles, and an additional SeaRAM launcher for greater air self-defense capacity.⁷⁸

77 The Navy would like to accelerate the transition from LCS to FF from FY 2019 to FY 2018, which would increase the number of FF from eleven to twelve and reduce the number of LCS from twenty-nine to twenty-eight. See Sydney J. Freedberg Jr., “The Navy Wants LCS ‘Frigate’ Upgrade a Year Earlier: 2018, not 2019,” *Breaking Defense*, May 18, 2016, available at <http://breakingdefense.com/2016/05/navy-wants-lcs-frigate-upgrade-a-year-earlier-2018-not-2019/>.

78 Ibid.

In the proposed fleet architecture, current and in-production LCSs and FFs would be used to perform the FFG missions described in Chapters 3 and 4. Consistent with the Navy's plans, LCSs would specialize in a set of surface combatant missions (e.g., ASW, SUW, MCM, etc.) and carry the same mission package for most of their lives.⁷⁹ Furthermore, in the proposed architecture LCSs would specialize by hull form as well. The monohull *Freedom*-class ships will be used primarily for ASW and SUW missions and carry those mission packages, and the *Independence*-class trimaran hull ships will be used for MCM and SUW because their larger mission bay improves their ability to act as an unmanned vehicle support vessel. Because they will conduct ASW and SUW missions, any FFs built in the proposed architecture will be based on the *Freedom*-class LCS. The two different hulls will be based appropriate for their missions. For example, *Independence*-class ships will be forward-stationed in Bahrain and Djibouti, and *Freedom*-class ships will be forward-stationed in Singapore.

In the proposed architecture, the LCS/FF program would be truncated as soon as the design of a new FFG is ready to build. This would ideally be in FY19, but may be FY20 or FY21. The 4000- to 5000-ton FFG would be designed with the endurance to accompany the Maneuver Force or for convoy escort; an active and passive EW suite; an ASW suite including a VDS sonar and passive towed array; and a 16- to 32-cell VLS magazine with ESSM for medium-range area air defense, long-range surface-to-surface missiles, and a standoff ASW weapon capable of quickly putting a submarine on the defensive more than 50 nm away.

Patrol vessels. The proposed fleet architecture includes a new class of 600- to 700-ton patrol vessels patterned on fast missile craft such as the Egyptian *Ambassador*-class or Swedish *Visby*-class ships. They have an endurance of about 2 weeks and carry four to eight SUW/strike missiles. Patrol vessels would have sufficient air defense capacity to protect them against enemy attacks until they expend their offensive weapons. For peacetime operations, the patrol vessels would conduct maritime security operations using embarked small boats and CUSVs.

Unmanned Surface Vehicles

Extra-Large Displacement USVs. XLUSVs with a displacement of more than 100 tons would support operations such as electronic intelligence, EW, mine warfare, and ASW.⁸⁰ They would carry and launch small UAVs, tow passive or active sonar arrays, deploy mines, tow minesweeping gear, and carry EM signal decoy equipment. Their relatively small radar signature and long endurance would enable them to operate with the Maneuver Force or the Deterrence Force.

79 Tom Rowden, "Statement from Vice Adm. Tom Rowden, Commander, Naval Surface Forces: Results from the Chief of Naval Operations Directed 60-Day Review of the Littoral Combat Ship Program," Department of the Navy, essay, September 8, 2016, available at <http://www.scout.com/military/warrior/story/1704745-navy-unveils-new-sharpened-lcs-strategy>.

80 The DARPA *Sea Hunter* vehicle has a 145-ton full load displacement. Sydney J. Freedberg Jr., "DSD Work to Christen DARPA's Robot Boat Sea Hunter," *Breaking Defense*, April 7, 2016, available at <http://breakingdefense.com/2016/04/dsd-work-to-christen-darpas-robot-boat-sea-hunter/>.

FIGURE 35: DARPA SEA HUNTER XLUSV

DARPA photo

Common Unmanned Surface Vehicle. The Navy's current CUSV is about the same size as existing small craft such as Rigid Hull Inflatable Boats (RHIB). They are used in the proposed architecture as part of MCM Groups, Counter-ISR Groups, and SAGs. The proposed architecture adds new payloads to the CUSV and expands the CUSV inventory significantly.

Amphibious Vessels

FIGURE 36: LX(R) AMPHIBIOUS WARFARE SHIP

Concept graphic courtesy of Huntington Ingalls Industries

As described in Chapter 5, the proposed fleet architecture replaces today's 3-ship ARG consisting of an LHA/LHD, an LPD, and a dock landing ship (LSD) with a 4-ship package composed of a CVL, an LPD, and two LX(R)s. Some USMC rotary aviation and rolling stock will move from the CVL to the third small deck amphibious ship to make room for additional F-35Bs and associated equipment. The proposed architecture calls for ten CVLs, which is about the size of the current LHA/LHD fleet.⁸¹

The Navy plans the LX(R) to be a variant of the LPD-17.⁸² In the proposed fleet architecture, the LPD-17 and LX(R) will evolve to support the range of Deterrence Force missions. In addition to taking on some of the aviation and amphibious capabilities displaced from CVLs, LPD-17s and LX(R)s would incorporate a 32-cell (approximately) VLS magazine to carry offensive missiles for SUW and strike. The VLS magazine could also carry ESSM interceptors to augment missile defense in regions where the air threat is high. The proposed architecture includes twenty-nine LPD-17 and LX(R) small-deck amphibious ships.

CLF Vessels

FIGURE 37: TANKER MT EVERGREEN STATE (T-AOT-5209)



Military Sealift Command photo

As described in Chapter 5, today's CLF of twelve T-AKEs, fifteen T-AOs (to be replaced by the T-AO(X)), and two T-AOEs is not a good mix for today's fleet and will be even more inappropriate for the more distributed posture of the proposed fleet architecture. Today's CLF structure has, relatively, too much capacity for dry cargo and not enough for fuel, because today ships receive most of their dry cargo via commercial shipping services when they pull

81 The proposed 4-ship ARG has more cubic square feet of cargo space and square feet of vehicle space than today's 3-ship ARG and can carry almost the same number of rotary wing aircraft. The Air Combat Element (ACE) configurations possible with the 4-ship ARG are described in Chapter 7. For more details, see Clark and Sloman, *Advancing Beyond the Beach*, pp. 42–44.

82 Kris Osborn, "Navy Preps to Build Next Generation LXR Amphibious Assault Ship," *Military.com*, May 26, 2015, available at <http://www.military.com/daily-news/2015/05/26/navy-preps-to-build-next-generation-lxr-amphibious-assault-ship.html>.

into port. The proposed architecture includes a rebalanced mix of twenty-six T-AOEs and four T-AKEs. This mix is achieved by modifying the Navy’s planned *John Lewis*-class T-AOs to enable them to carry a relevant amount of ammunition and other dry cargo (thus classifying them T-AOEs); constructing additional T-AOEs; and placing most of the T-AKEs in a wartime reserve status.

Replenishment ships. Today’s CLF also relies on T-AOEs and T-AKEs returning to port for fuel or supplies. In wartime, these ports may not be available, and long transits will make CLF ships more vulnerable to attack. To improve CLF efficiency and resiliency in wartime, the proposed architecture includes large T-AOTs and T-AKs to act as supply stations at sea for T-AOEs (and possibly T-AKEs), so they don’t have to return to a distant port for resupply. These two ship classes are already part of the Maritime Prepositioning Force; the required additional T-AKs and T-AOTs can be leased from commercial providers when needed.⁸³

To further improve CLF resiliency, the new architecture equips CLF ships with self-defense systems for air threats such as SeaRAM. To help rearm Deterrence Force and Maneuver Force ships, T-AKE will incorporate VLS reloading equipment such as cranes and associated handling gear.

VLS resupply ship: In addition to having VLS reload gear on dry cargo ships, the Deterrence Force would include a surface combatant resupply vessel, notionally built on a T-AKE hull. The ship would have a VLS magazine that enables rapid, in-stream VLS canister resupply of supported surface combatants. Although it would not have its own sensors, the resupply ship would also be able to launch missiles “on remote” if circumstances demand additional long-range fires.

FIGURE 38: EPF (NEAR-TERM UNMANNED VEHICLE SUPPORT VESSEL)



U.S. Navy photo by Thigpen Photography, Inc

83 Military Sealift Command, “Sealift,” in *The U.S. Navy’s Military Sealift Command 2015 in Review*, (Norfolk, VA: Department of the Navy, September 30, 2015), available at <http://www.msc.navy.mil/annualreport/2015/pm5.htm>.

Unmanned Vehicle Support Vessels/Tenders

The proposed fleet architecture includes squadrons of patrol vessels, unmanned vehicles, and SSNs in locations that may lack the necessary sustainment and maintenance infrastructure. To support these ships, the architecture includes tenders and unmanned vehicle support vessels.

In the near-term, current submarine tenders (AS), ESBs, and EPFs would be used to address these needs. The Navy's two AS, currently in Guam, would continue operating there, and EPFs and ESBs could be used to support unmanned vehicles and patrol vessels, respectively.

Tenders. Traditionally, tenders provide vessel repairs, logistical support, supplies, and administrative services for forward-based ships and crew. A nuclear submarine tender adds specialized equipment to maintain undersea vessels, carry and manipulate radioactive material, and load submarine ordnance. Some tenders also serve in a command role, offering squadron leaders a secure planning facility.

Aside from the U.S. Navy's *Emory S. Land*-class AS, no current template exists for tenders beyond Germany's small *Elbe*-class replenishment ship, currently used to support fast attack craft and submarines in the Baltic Sea. The future tender would need workshops, large access openings, surge berthing, cranes, electrical generators, and water distillation capability. They should also have aviation capability to enable aircraft maintenance and resupply, including hangar space. In the proposed fleet architecture, additional tenders will be built using the same or similar 10,000-ton hull as the *Emory S. Land*-class.

FIGURE 39: SUBMARINE TENDER USS EMORY S. LAND (AS-39)



Military Sealift Command photo

Unmanned vehicle support vessels. These ships would need the ability to host multiple aircraft simultaneously, modular workshops that could be reconfigured to accommodate new vehicles as they enter the force, storage for spare vehicle modules and sensors, and

ammunition magazines. This would enable them to support maintenance, payload swap-out, decontamination, and resupply/rearmament. They would also need berthing to support fly-away teams to resolve issues on UAVs stationed aboard combatants.

Tenders and support vessels would need to be capable of underway replenishment so they would not need to go to port to be resupplied and refueled.

FIGURE 40: ESB (NEAR-TERM PATROL VESSEL TENDER)



Military Sealift Command photo

Salvage Ships

Salvage and towing ships are a vital and often unrecognized part of a ready fleet. America's four *Powhatan*-class fleet tugs and four *Safeguard*-class salvage vessels are at the end of their service lives—but still in high demand. Aside from their primary mission of supporting the recovery of damaged combatants, salvage vessels can support unmanned vessels and vehicles, survey and open unfamiliar ports, and aid in mine clearing.

The proposed fleet architecture suggests that these vessels may need to be recapitalized in greater numbers either via acquisition of vessels already on the open market, or constructed as part of the Navy's planned combined salvage ship fleet tug (T-ATS(X)) program.

Weapons, Sensors, and Mission Systems

The operating concepts and force packages described above require new or modified weapons, sensors, and other mission systems. The Navy is developing or fielding some of these payloads today, but must make difficult choices to cancel, truncate, or eliminate systems that do not support either future ways of fighting or the imperative to deter great powers in highly contested areas. Specifically, the new fleet architecture requires the following payloads:

Air and missile defense. To survive initial attacks and persist in highly contested environments, naval forces need higher-capacity missile defenses that do not take away from their capacity for offensive operations. Today, surface combatant VLS magazines are increasingly being devoted to air defense interceptors. As described in Chapter 3, naval forces will need to shift to a medium-range missile defense concept and accelerate the fielding of smaller, fire-and-forget interceptors such as the RIM-162 ESSM Block II.⁸⁴ Air defense operations would use longer-range interceptors such as the RIM-174 SM-2 and SM-6 to engage aircraft before they attack surface combatants.

The medium-range missile concept also enables naval forces to use line-of-sight non-kinetic defenses such as EW and directed energy. The Navy should accelerate fielding of the SLQ-32 SEWIP Block 3 EW system, and they should develop lasers and HPRF weapons for shipboard use. A 400-kW solid-state laser could be installed on and powered by a DDG-51 Flight III's shipboard power supplies, and an HPRF system like a higher-power version of the Army's HPRF demonstrator tested in 2013 could also be developed and integrated for shipboard use.⁸⁵

Electromagnetic spectrum warfare. To further decrease the size of salvos that ships must defeat, naval forces will need to reduce their detectability, degrade enemy sensors, and increase the number of false targets an enemy would need to engage. Naval forces will therefore rely to a much greater degree on LPI/LPD and passive sensors and communications systems, networked and intelligent sensor countermeasures, and persistent decoys.

The Navy will need to accelerate fielding of passive EM sensor systems on ships such as SLQ-32-SEWIP, Ships Signal Exploitation Equipment (SSEE) Block F, and the development of new EO/IR sensors such as the Office of Naval Research's (ONR) Combined EO/IR Surveillance and Response System (CESARS). Because these sensors are limited by the horizon, the Navy will need to accelerate fielding of long-endurance UAVs such as TERN and USVs such as the CUSV that can carry these sensors. Smaller versions of these systems are needed to deploy on UUVs such as gliders and MDUUVs which could exploit their ability to get close to targets and pass targeting information back to weapons platforms using highly directional LPI/LPD communications.

84 The ESSM Block I interceptor requires an illuminator radar to be guided to the target, which limits the number that can be employed against a given salvo. ESSM Block II has a fully active seeker, so it can track and engage a target even if the illuminator must move on to a new target. Department of the Navy, *U.S. Navy Program Guide 2015* (Washington, DC: Department of the Navy, 2015), p. 43, available at <http://www.navy.mil/strategic/top-npg15.pdf>; and Frank Cevasco, "Evolved SEASPARROW Missile: The Evolution Continues," *Common Defense Quarterly*, Fall 2012, pp. 60–61, available at http://www.raytheon.com/capabilities/rtnwcm/groups/public/documents/download/rms12_essm_evolution.pdf.

85 See Clark, *Commanding the Seas*, p. 21; Ronald O'Rourke, *Navy Shipboard Lasers for Surface, Air, and Missile Defense: Background and Issues for Congress*, R41526 (Washington, DC: CRS, July 31, 2014), available at <http://fas.org/sgp/crs/weapons/R41526.pdf>; and Dan Parsons, "Raytheon Revives High-Powered Microwave for Counter-UAS Mission," *Defense Industry Daily*, June 20, 2016, available at <http://www.defensedaily.com/raytheon-revives-high-power-microwave-for-counter-uas-mission/>.

FIGURE 41: MALD DECOY

Photo courtesy of Raytheon Company

Unmanned vehicles can also carry active EM systems to act as persistent decoys or as jammers to degrade enemy EM sensors, like the U.S. Air Force's Miniature Air Launched Decoy (MALD). MALD is an expendable jammer or decoy, but a mission package like the one in a MALD could be employed by naval forces on small unmanned vehicles. Unmanned vehicle-based EM systems would be networked with the ships and aircraft being protected to ensure their operations are coordinated for obscuring ship movements and helping to hide the transmissions naval forces are compelled to make. The need for highly coordinated EM operations will require that the Navy accelerate the integration of networked and intelligent EW controllers into EMS warfare systems, such as those in the DARPA Behavioral Learning for Adaptive Electronic Warfare (BLADE) and Adaptive Radar Countermeasures (ARC) programs and ONR's Netted Emulation of Multi-Element Signatures Against Integrated Sensors (NEMESIS) program.

ASW and undersea warfare. Offensive ASW concepts require deployable sonar arrays, such as TRAPS, that can be placed in likely enemy submarine operating areas; smaller LFA sonar transducers that can be carried by XLUSVs; and smaller passive arrays that can be towed by XLUUVs, glider UUVs, and MDUUVs. Future defensive ASW concepts will exploit the ability of low Pk torpedo attacks to suppress submarine operations; this requires small, affordable ASW torpedoes such as the Navy's Common Very Light Weight Torpedo (CVLWT) and standoff ASW weapons such as a longer-range version of the Navy's RUR-130 ASW rocket (ASROC).

Surface and strike warfare. New concepts such as Distributed Lethality will depend on passive and LPI/LPD sensors as described above to obtain targeting information in a challenging communications environment where third-party targeting from satellites or other long-range sensors may not be available. New strike and SUW concepts will also rely on ships carrying standoff ASW, ASUW, and strike weapons with sufficient range to exploit fleeting targeting information and in large enough numbers to defeat enemy ships and facilities supporting their operations as well as attack targets to punish enemy aggression.

Previous CSBA studies noted that the best weapons range to achieve a combination of capacity and reach is from 100 to 500 nm.⁸⁶ Longer-range weapons are too large to be carried in current launchers or in great enough numbers; shorter-range weapons will place the launch platform too close to the target to circumvent enemy defenses or avoid an immediate counterattack.

To maximize the capacity of ships and submarines for offensive operations, the Navy should continue development of multi-mission surface combatant weapons for strike and SUW such as the RIM-174 SM-6 missile and BGM-109 Tomahawk. Similarly, the Navy should continue developing additional variants of Mk-48 heavyweight torpedoes that can conduct SUW, ASW, and strike operations against undersea infrastructure ashore. In addition to planned air-launched strike weapons such as LRASM, the Navy should pursue powered versions of glide weapons such as the AGM-154 Joint Standoff Weapon (JSOW) and GBU-53/B SDB Increment II to enable them to conduct standoff attacks at 100 to 500 nm.⁸⁷

Mine warfare. The continued shift of offensive mine warfare and MCM operations to unmanned systems will require the Navy to invest in some of the same unmanned vehicles needed for other missions as described above, but with modular payloads to support mine warfare missions. For offensive mining, the Navy should develop and field MDUUVs and micro UUVs that can act as mobile smart mines, classify potential targets, and be positioned near the area to be mined by XLUUVs and XLUSVs.

For MCM operations, the Navy should continue its current investment in CUSVs with the Mk-104 Unmanned Influence Sweep System (UISS), the towed AN/AQS-20A minehunting sonar, Mk-18 Mod II Kingfish minehunting SDUUV, and MQ-8C Firescout UAV with EO/IR sensors. It should expand on these systems, however, by fielding a long-endurance UAV such as TERN that could conduct radar and laser searches for surface and shallow mines using a system like the Airborne Laser Mine Detection System (ALMDS) and carry the Airborne Mine Neutralization System (AMNS). These systems are currently planned to be carried by the MH-60 helicopter, which only has one-fourth the endurance expected from TERN.

86 Mark Gunzinger and Bryan Clark, *Sustaining America's Precision Strike Advantage* (Washington, DC: Center for Strategic and Budgetary Assessments, 2015), pp. 36–45.

87 Kris Osborn, "Ship-Killer: The U.S. Navy's New Precision-Guided Missile Is a Big Deal," *The National Interest*, June 17, 2016, available at <http://nationalinterest.org/blog/the-buzz/ship-killer-the-us-navys-new-precision-guided-missile-big-16630>.

FIGURE 42: MK-18 UNMANNED UNDERWATER VEHICLE



U.S. Navy photo

Amphibious warfare. New approaches for amphibious warfare such as the Marine Corps Operations Concept and Littoral Operations in a Contested Environment concept will require capabilities for Marines to conduct distributed operations over wider areas in contested conditions. In addition to the ship and aircraft changes described above and in Chapter 7, amphibious forces will need new surface connectors that are able to better protect themselves and the large equipment such as tanks, armored personnel carriers, and missile launchers they transport ashore. Today's Landing Craft Air Cushioned (LCAC) and Landing Craft Utility (LCU) should be equipped with short-range active protection systems (APS) such as those used on the armored vehicles of many NATO allies to defend them from small missiles and rocket-propelled grenades (RPG). They should be replaced with connectors such as the Ultra-Heavy Amphibious Connector, which uses large foam-filled treads for flotation and ground movement; the treads can also provide a measure of protection from RPGs and small arms fire.

As described in Chapter 3, amphibious forces will need ground-based air defenses such as interceptor and directed energy versions of IFPC, and EW systems. They will also need to employ camouflage and decoy systems to further increase the number of weapons an adversary would have to use for a successful attack on expeditionary units. To enable EABs to contribute to Distributed Lethality, they will also need more surface-to-surface missile

launchers such as HIMARS, which can carry the Army Tactical Missile System (ATACMS), for which the Army is also developing an anti-ship variant.⁸⁸

88 The Army's replacement for ATACMS is the Long-Range Precision Fires (LRPF) missile. The Army plans to develop an anti-ship seeker for this missile. See Jason Sherman, "DOD Project would Add Anti-Ship Capability to Army's Premier Long-Range, Guided Missile," *Inside Defense*, October 28, 2016; and Sydney J. Freedberg Jr., "New Army Long-Range Missile Might Kill Ships, Too: LRPF," *Breaking Defense*, October 13, 2016, available at <http://breakingdefense.com/2016/10/new-army-long-range-missile-might-kill-ships-too-lrpf/>.

CHAPTER 7

Implications for Naval Aviation

Although ships are the most prominent element of the fleet, aircraft have become essential to naval operations over the last century. For example, today fixed-wing strike fighters are the fleet's primary means of strike and anti-ship attack, and only shipboard helicopters or fixed-wing patrol aircraft can conduct ASW at sufficient range to protect ships from submarine-launched torpedoes and ASCM attacks.

The operational concepts, force packages, and posture of the proposed fleet architecture have significant implications for naval aviation. The number and type of aircraft needed on ships and onshore will change, and requirements for the capabilities they carry will evolve to reflect new tactics, techniques, and procedures (TTP). The following sections address these implications for Maneuver and Deterrence Force CVWs, fixed and rotary-wing maritime patrol aircraft, and unmanned aerial vehicles.

The proposed fleet architecture has its greatest impact on carrier air wings, which will operate differently than today with the advent of CVLs in the Deterrence Force, the new role of CSGs in the Maneuver Force, and the introduction of a CSG to the Deterrence Force in Northern Europe. The aviation implications of the proposed fleet architecture are described below in terms of Maneuver Force CVWs. Deterrence Force CSG CVWs and CVL air wings are then described in terms of their differences from Maneuver Force CVWs.

Maneuver Force CVW Missions

A central driver for Maneuver Force CVW design is minimizing the time for the Maneuver Force to respond in support of a Deterrence Force countering adversary aggression. As it withdraws, the Deterrence Force would become preoccupied with surviving and recovering from the initial round of combat, which may provide the enemy an opportunity to gain the initiative. To shorten this window of vulnerability, the Maneuver Force would need to engage the enemy even as the Deterrence Force retires.

Long-range strike

The worst-case scenario for a conflict under the proposed fleet architecture would be to have no indications or warning of imminent aggression with the Maneuver Force at the farthest reach of its Indo–Asia–Pacific area of operations. As shown in Figure 43, the Maneuver Force could start from the Western Indian Ocean or Central Pacific Ocean when conflict breaks out and arrive about 2000 nm from the Chinese coast when the Deterrence Force needs to withdraw after 2 days of combat.

A 2000-mile combat sortie, however, would take at least 10 hours round-trip, which exceeds the reasonable endurance of a pilot in an ejection seat.⁸⁹ For these missions, the CVW would therefore need an Unmanned Combat Aerial Vehicle (UCAV) with an unrefueled combat radius of greater than 500 nm to ensure refueling aircraft could remain outside the reach of adversary air defenses and defensive CAPs. The vehicle would also need to be stealthy, so it can penetrate the highly contested airspace near the Chinese mainland.

FIGURE 43: MANEUVER FORCE CVW RANGE NEEDED TO REACH TARGETS THROUGHOUT THE EAST OR SOUTH CHINA WITHIN 2 DAYS



89 Federal Aviation Administration, “Pilot Flight Time, Rest, and Fatigue,” fact sheet, January 27, 2010, available at https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=6762.

The UCAV would not have the characteristics, however, that enable it to be an efficient multi-mission aircraft. To minimize the UCAV's radar signature, it would likely have a "flying wing" structure like a B-2 bomber or the TERN UAV (see Figure 46) that lacks traditional wings or a tail. This design reduces the number of surfaces that can reflect radar energy, but also reduces the aircraft's lift and, in turn, payload or endurance. Therefore, the UCAV would not have the very long endurance and high payload capacity desired for refueling, logistics, or surveillance missions.⁹⁰

Counter-air

The threat from enemy ASCMs and ASCM-equipped bombers will increase as the Maneuver Force approaches the conflict area. New air defense concepts such as those described in Chapter 3 will improve the ability of naval forces to defeat individual ASCMs, but the capability to destroy missile launchers and associated sensors offers the greatest potential to defeat entire enemy salvos. With the ranges of air-launched ASCMs increasing to 1000 nm, ships may not be able to use long-range surface-to-air interceptors such as SM-6s to engage enemy bombers before they can launch their ASCMs.⁹¹ CVW aircraft will need to conduct this counter-air mission. Long range ASCMs also enable an adversary's bombers to launch attacks on the incoming Maneuver Force while the bombers are still protected by shore-based air defenses: defenses that can reach out to about 500 nm, depending on the target's altitude.⁹²

Counter-air operations will require low observable manned fighters with an unrefueled combat radius of more than 500 nm. These characteristics will keep refueling aircraft out of range of enemy air defenses while enabling the fighters to reach and engage bombers in a dynamic environment inside the enemy's air defense envelope. In contrast to today's multi-mission strike-fighters, such as the F-35C, the design of these aircraft would need to focus mostly on the fighter mission rather than strike, so that they would have the speed, endurance, maneuverability, and air-to-air sensor capability needed for counter-air operations.

CVN-based fighters could also escort strikes by long-range bombers based outside the region to defend them from enemy fighter CAPs. As the United States fields more stealthy bombers, adversaries will increasingly use fighter aircraft to find them with visual or IR sensors, compelling them to employ large, expensive standoff weapons such as the Joint Air-to-Surface Standoff Missile (JASSM)—instead of less expensive short-range glide bombs such as the

90 Zachary Keck, "Are U.S. Fighter Jets About to Become Obsolete?" *The National Interest*, April 11, 2015, available at <http://nationalinterest.org/blog/the-buzz/are-us-fighter-jets-about-become-obsolete-12612>.

91 Jeffrey Lin and Peter Singer, "China Shows Its Deadly New Cruise Missiles," *Popular Science*, March 10, 2015, available at <http://www.popsi.com/china-shows-its-deadly-new-cruise-missiles>.

92 Since an air defense radar operates in a frequency range that does not enable it to see over the horizon, a low-altitude aircraft may be able to get closer before being detected. Also see Dave Majumdar, "Russia's Deadly S-5000 Air Defense System Ready for War at 660,000 Feet," *The National Interest*, May 3, 2016, available at <http://nationalinterest.org/blog/russias-deadly-s-500-air-defense-system-ready-war-660000-16028>.

Joint Direct Attack Munition (JDAM). In addition to increasing the cost of strikes, driving U.S. forces to use standoff weapons will reduce the size of strike salvos and increase the probability they would be defeated by enemy air defenses.⁹³

Short-range strike

The Maneuver Force could employ manned strike aircraft to conduct integrated operations with long-range strike and counter-air aircraft, as well as independent operations in less contested environments or after degrading long-range anti-ship and air defense threats. In the 2030s, this force will consist of stealthy 5th generation F-35Cs and (at that point) aging 4th generation F/A-18 E/F Super Hornets. In the proposed fleet architecture, these aircraft could conduct maritime strike, CAS, and suppression of enemy coastal air defenses. They could also defend the Maneuver Force from air threats by supporting CAPs.

Sustained short-range strike operations in relatively permissive environments, such as those U.S. forces conducted in Iraq and Afghanistan over the last decade, will likely continue to be required in the 2030s. These missions would usually be addressed by Deterrence Force CVLs, as described below, supported when needed by Maneuver Force CVW strike-fighters, unmanned surveillance aircraft, and unmanned tanker aircraft.

Airborne electronic attack

As described in Chapter 3, naval forces will need to adopt a passive and LPI/LPD approach to EMS warfare. Today, AEA aircraft mostly conduct high-power standoff jamming of enemy sensors from outside the range of air defense systems. By 2030, these high-power approaches will give way to stealthy manned aircraft and unmanned underwater, surface, and aerial vehicles conducting low-power stand-in jamming inside the enemy's air defense envelope.

Manned AEA aircraft such as today's E/A-18G will shift to conducting LPI/LPD standoff jamming operations in which narrow beams and highly adjustable power levels combine to reduce counter-detection risks to the jammer. The Maneuver Force CVW will continue to include E/A-18Gs, but will also include unmanned vehicles in its Counter-ISR Groups to support EMS Warfare missions inside the enemy's air defense envelope, such as jamming or decoy operations.

Support, including refueling

The combat radius of a stealthy manned carrier-based fighter may be limited to 600–700 nm, due to constraints on lift and fuel capacity imposed by low observable aircraft design and

93 A previous CSBA report describes this aspect of the salvo competition at length. See Gunzinger and Clark, *Sustaining America's Precision Strike Advantage*, pp. 13–19.

by the size limitations imposed by carrier compatibility.⁹⁴ Aerial refueling will be needed for any longer-range missions, which for strike and strike escort missions could come from land-based tankers.

The mission in which organic CVW refueling will be most obviously necessary is defensive counterair (DCA) operations around the Maneuver Force. To intercept enemy aircraft before they get close enough to launch their ASCMs, U.S. fighters would need to loiter 300 nm to 1000 nm away from their CVN depending on the type of ASCM being carried by enemy aircraft. Although fighters could reach this range, they would not be able to remain there for more than about an hour without refueling. The CVW needs organic aerial refueling to enable longer sorties and maximize the efficiency of combat air patrols (CAP). Other fighters could support refueling, but this would take them away from tactical missions and consume their service life, a problem the U.S. Navy is encountering today.⁹⁵

Because it would be able to remain outside the most highly contested areas, a refueling aircraft could have a higher signature than a stealthy aircraft such as the UCAV or F-35—and therefore have greater endurance and payload. It could also be unmanned, since refueling operations are relatively simple, particularly when compared to counter-air or close air support missions. This would further expand its endurance.

With its payload and range, an unmanned utility aircraft could also support a range of other missions, such as deploying decoys to defeat adversary sensors or launching standoff weapons and unmanned vehicles. In permissive environments, it could provide long loiter times for responsive strike missions similar to today's MQ-1 Predator or MQ-9 Reaper. A utility UAV could also augment the Navy's planned MV-22 carrier onboard delivery aircraft to provide logistics support to deployed forces, particularly in wartime when the Deterrence Force and Maneuver Force are operating in a distributed manner with less access to ports or CLF ships.

CVW Organization

An important benefit of the new fleet architecture is the ability to conduct larger-scale air operations that integrate the CVWs of the two Maneuver Force CSGs and incorporate Deterrence Force CVL air wings. For example, when the Maneuver Force joins the Deterrence Force in the Western Pacific, the CVL strike-fighters can support CAP operations for the

94 U.S. Air Force, "F-22 Raptor," fact sheet, September 23, 2015, available at <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104506/f-22-raptor.aspx>; Eric Tegler, "Why the F-22 is Such a Badass Plane," *Popular Mechanics*, June 14, 2016, available at <http://www.popularmechanics.com/military/a21232/why-the-f-22-raptor-is-such-a-badass-plane/>; and Global Security, "F-35 Joint Strike Fighter (JSF) Lightning II: Specifications," updated April 14, 2016, available at <http://www.globalsecurity.org/military/systems/aircraft/f-35-specs.htm>.

95 Megan Eckstein, "Navy Digging Out of Fighter Shortfall; Marines Still Struggling to Fly at Home," *USNI News*, April 26, 2016, available at <https://news.usni.org/2016/04/26/navy-digging-out-of-fighter-shortfall-marines-still-struggling-to-fly-at-home>; and S. McDougall, "UCLASS Becomes Unmanned Tanker as U.S. Navy Offsets Fighter Shortfall," *Forecast International*, February 4, 2016, available at <http://www.forecastinternational.com/news/index.cfm?l3=30102&recno=238259>.

combined force or focus on CAS for amphibious forces while the CSG CVWs provide air defense to the CVLs.

Within the Maneuver Force, aircraft could be shifted between the two CSGs, so one CSG supports ongoing operations, while the other rearms and makes repairs or modifications on both carriers' aircraft. And with multiple CVW aircraft available, the Maneuver and Deterrence Force could provide aircraft to the joint force, such as fighters and UCAVs to support land-based bombers, and have enough strike-fighters remaining for CAP, SUW, or CAS operations closer to the CVN. To fully exploit approaches like these, the proposed fleet architecture combines the Maneuver Force's two CVWs into one large CVW. This model would require a larger air wing staff, but would be better suited for large-scale multi-dimensional war at sea.

Composition of Maneuver Force CVWs

To implement the new fleet architecture, Maneuver Force CVWs will need a different composition than today's CVWs of four strike-fighter squadrons, one AEW squadron, one AEA squadron, and a helicopter squadron.

As noted above, the new CVW will need two types of unmanned vehicles: a UCAV and a tanker/utility aircraft. Six UCAVs in a squadron would yield four to five operational aircraft to support initial long-range attacks as the Deterrence Force retrogrades. With two CVWs in the Maneuver Force, eight to ten aircraft would be able to engage the enemy from long range. Similarly, a squadron of six unmanned utility aircraft per CVW would be able to maintain eight to ten operational tankers total, which would be enough to support the CAPs and escort operations of both CVWs.

Among the manned aircraft, the new Maneuver Force CVW would include a fighter squadron not in today's CVW; F-35C strike-fighters; and the AEW, AEA, and helicopter squadrons in today's CVW. The proposed organization essentially replaces two strike-fighter squadrons in today's CVW with a fighter squadron and a combined unmanned utility/strike aircraft squadron.

Overall, the combined Maneuver Force CVWs would consist of 110 aircraft distributed over two CVNs as depicted in Figure 44.

FIGURE 44: COMPOSITION OF THE COMBINED MANEUVER FORCE CVW**Two V(U)A squadrons:**

Each with 6 x long-range, low-observable unmanned strike aircraft

**Two VF squadrons:**

Each with 12 x low-observable fighters

**Four V(F)A squadrons:**

Each with 10 x F-35 multi-mission tactical aircraft

**Two VAQ squadrons:**

Each with 6 E/A-18G Electronic Warfare aircraft

**Two VAW squadrons:**

Each with 5 E-2D AEW/C2 aircraft

**Two VRC squadrons:**

Each with 6 unmanned utility/tanker aircraft

**Deterrence Force CSG CVW**

Maneuver Force and Deterrence Force CSG CVWs would differ only in the mix of aircraft. Because of its mission to deter Russian ground warfare against the Baltic NATO allies, the Northern Europe Deterrence Force's CSG CVW would need more manned strike-fighter aircraft to conduct close air support for ground forces. Given the denser and more sophisticated air defenses along the Russian border, it would also need more AEA aircraft to suppress air defenses, and utility tankers to enable long-range manned sorties. The CVW would have fewer UCAVs and fighters compared to the Maneuver Force CVW.

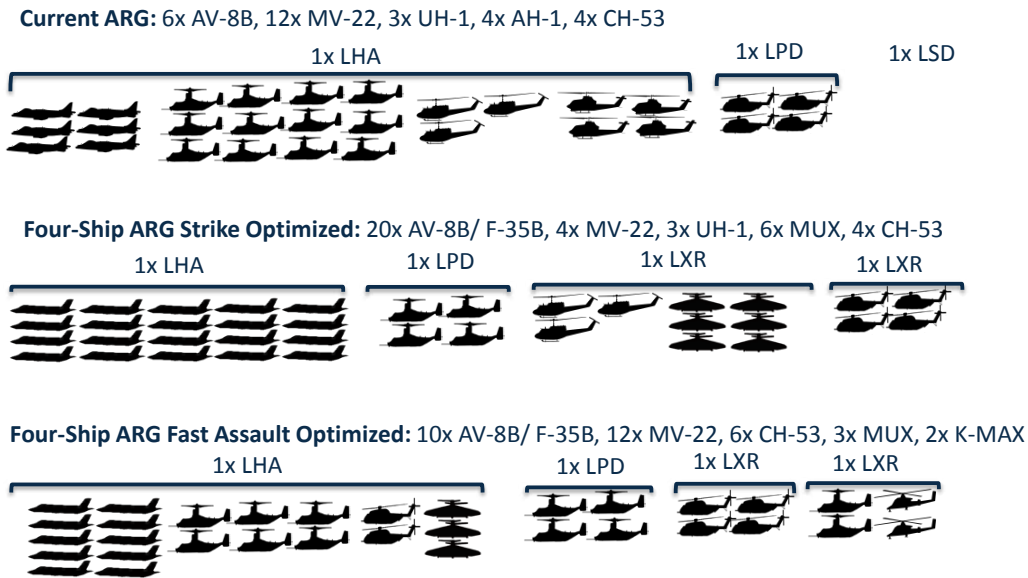
CVL Air Wings

The ACE on today's LHA/LHDs will evolve to be an air wing with its own Marine Corps command structure and organization. CVL air wings will consist of about twenty F-35Bs, which can provide ISR, AEA, and targeting for the small-scale CAS, SUW, and strike attacks it will need to undertake as part of the Deterrence Force. This number of F-35Bs can be supported by the Marine Corps' planned procurement of F-35Bs. It would impact the number available for shore-based operations under the Unit Deployment Program (UDP), but UDP operations could

be supported by ARGs that are in the region, which would also increase the flexibility of the ARG ACE, since it would have multiple airfields ashore from which it could operate.

For AEW and C2, LHA/LHD air wings will rely on shore-based maritime patrol aircraft and E-2Ds. Variations possible in the ACE associated with the proposed 4-ship ARG are shown in Figure 45.

FIGURE 45: COMPOSITION OF 3- AND 4-SHIP ARG ACES



As the Navy builds CVLs with catapults and arresting gear, the CVL air wing will evolve to add one to two UCAVs, one to two utility/tanker unmanned vehicles, one to two AEW aircraft, and AEA aircraft needed for the threat environment.⁹⁶ This evolution will require Navy-Marine Corps air wing integration, as is done today in CVN CVWs.

Implications for Maritime Patrol Aircraft (MPA)

The proposed architecture implies few changes to the Navy’s planned manned and unmanned family of fixed- and rotary-wing patrol aircraft, which would evolve to conduct the missions described in Chapter 3.

96 When the Navy modernized the USS *Midway* in 1963, it added catapults, arresting gear, and an angled deck. This grew the displacement of the ship from 40,000 tons to 60,000 tons and increased its aircraft capacity from about forty to about sixty aircraft. The proposed CVL would not be as large as the modernized USS *Midway*, but between the two versions in terms of aircraft capacity.

Rotary-wing aircraft. Today shipboard helicopters conduct ASW with dipping sonar and sonobuoys and are the main means for surface combatants to attack small boats beyond the range of small arms, sweep for mines, and gain situational awareness over the horizon. Helicopters will continue to perform these missions in the proposed fleet architecture, but they will be augmented or replaced in some cases by rotary-wing UAVs.

FIGURE 46: DARPA TERN MALE UAV



DARPA concept graphic

The Navy fielded the MQ-8B Firescout UAV in 2011. It and the larger follow-on MQ-8C carry an EO/IR sensor for surveillance and targeting and will soon be able to employ CVLWTs and AGM-114 Hellfire missiles to engage submarines and small boats.⁹⁷ The DARPA TERN UAV will reach the fleet by 2020, which will further increase the capability of shipboard rotary-wing aircraft by carrying payloads of up to 500 lbs. on missions for 12 hours at ranges of 600 nm. The proposed architecture assumes TERN will replace the MQ-8 family of UAVs and that each surface combatant has at least two TERNs, which can fit in the space of one MH-60

⁹⁷ Sydney J. Freedberg Jr., "Fire Scout Drone Grows Up: Getting Radar, Rockets," *Breaking Defense*, December 17, 2014, available at <http://breakingdefense.com/2014/12/fire-scout-grows-up-drone-getting-radar-rockets-2016-ioc/>.

helicopter.⁹⁸ Per the concepts described in Chapter 3, TERN UAVs could be remote SUW and AAW sensors, or, using targeting information from a manned ship or aircraft, TERNs could be used as weapons launch platforms. As sensor capability and autonomy improve, multiple TERNs could operate together to find surface and submerged targets and engage them.

Fixed-wing aircraft. As described in Chapter 3, the proposed fleet architecture uses P-8As as a critical link in the chain of sensors gathering peacetime intelligence on competitor submarines and tracking out-of-area deployers. In wartime, P-8As provide the speed to pounce on enemy submarines detected by air-deployed sonobuoys, seabed and unmanned vehicle-borne sonar arrays, or ship and submarine sonars. The Navy is expanding the capacity of its MPAs with the MQ-4C Triton UAV. Unlike the P-8A, the MQ-4C only carries radar and EO/IR sensors and does not have a sonar or weapons capability. The proposed fleet architecture uses MQ-4Cs primarily for peacetime active radar sensing and wartime passive sensing as part of the new approach to EMS warfare described in Chapter 3.

98 Daniel Wasserbly, "DARPA Eyes 2018 for TERN UAVs First Flight," *IHS Jane's Defence Weekly*, May 11, 2016, available at <http://www.janes.com/article/60245/darpa-eyes-2018-for-tern-uav-s-first-flight>; and David Axe, "Pentagon's Mad Scientists Want to Launch Killer Drones From Small Warships," *Wired*, March 4, 2013, available at <https://www.wired.com/2013/03/darpa-drones-ships/>.

CHAPTER 8

Readiness and Training Cycles

The number of each type of unit needed in the overall fleet architecture results from the number deployed at any given time and the rotational readiness cycle that prepares them for deployment. The length of the cycle will affect the number of units needed to ensure the cycle sustains one unit continuously deployed. For example, a unit that deploys for 6 months each 2-year cycle will need at least four units to maintain one continuously deployed.

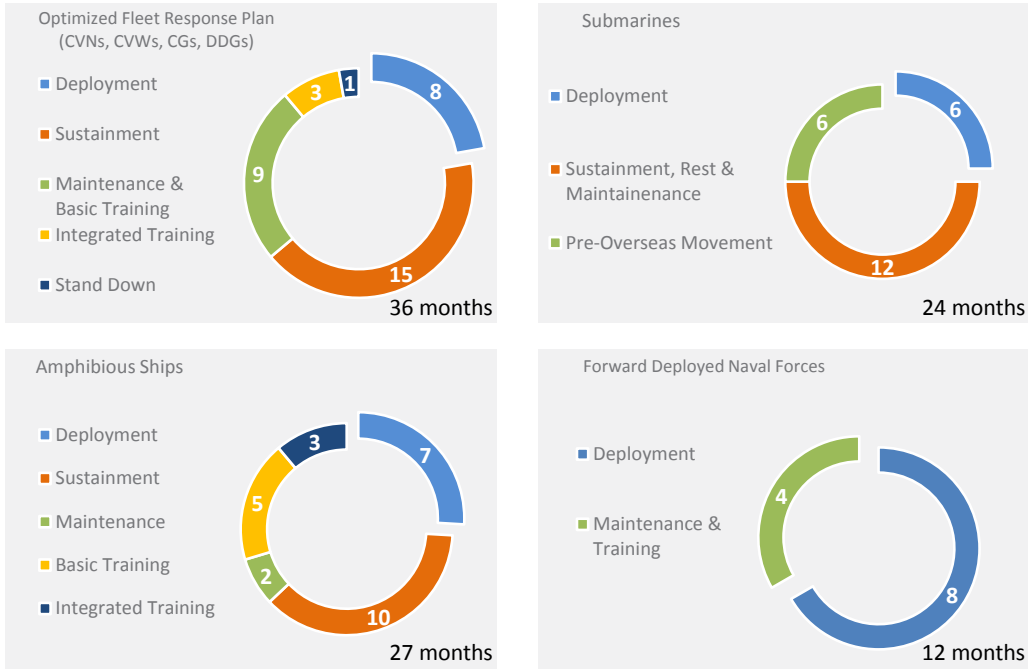
U.S. naval forces currently operate in rotational cycles consisting of deployments, maintenance, training, and certification for the next deployment. Different platform types use different rotational cycles based on their maintenance requirements and complexity of training. Rotational cycles also differ between those based in CONUS and those based overseas. Figure 47 depicts the cycles currently used by most naval forces.⁹⁹

As Figure 47 shows, deployments only comprise a portion of a platform's overall operational cycle. For example, ships and aircraft in the OFRP deploy 7 to 8 months out of each 36-month cycle, for an operational availability of about 19 percent. Platforms, however, are not completely unavailable during the rest of the cycle. The sustainment period that follows deployment is intended to allow a ship or aircraft to deploy again if needed to support emergent operational needs such as disaster response or a conflict. The Navy does not, however, normally fund the fuel and maintenance needed to keep platforms in an operational status during the sustainment period.¹⁰⁰ The only instances when this period has been funded over the past several years were in support of a surge carrier deployment to prevent gaps in overseas carrier presence.

99 There are different rotational cycles used by small numbers of platforms in very specific situations, such as FDNF SSNs in Guam or Riverine Forces. See CNO, *Optimized Fleet Response Plan*, OPNAVINST 3000.15A (Washington, DC: Department of the Navy, November 10, 2014).

100 Megan Eckstein, "CNO Greenert: Navy Could Fix Readiness Shortfall by 2020 if Sequestration is Avoided," *USNI News*, March 10, 2015, available at <http://news.usni.org/2015/03/10/cno-greenert-navy-could-fix-readiness-shortfall-by-2020-if-sequestration-is-avoided>; and CNO Admiral Jonathan W. Greenert, "FY 2016 Department of the Navy Posture," testimony before the Senate Committee on Appropriations, Subcommittee on Defense, March 4, 2015.

FIGURE 47: CURRENT NAVY READINESS CYCLES



Following sustainment, platforms enter a maintenance period of varying length depending on the amount of emergent and scheduled work needed. When maintenance is complete, ships and aircraft enter a period of training and certification before their next deployment. Units in CSGs and ARGs conduct two phases of training: basic training as a single unit and integrated training as a complete group.

The 36-month OFRP cycle applies to CONUS-based CVNs, CVWs, and CSG surface combatants. It was initiated in 2014 because ships were not able to complete all their required maintenance and training between deployments in the previous 32-month FRTP cycle.¹⁰¹ Delays in completing maintenance were the main cause, driven by growth in maintenance periods for aging ships (some of which had deferred required maintenance in order to meet operational commitments) that also delayed subsequent ships starting their maintenance periods. This problem was most acute for aircraft carriers, which normally only conduct their dry dock maintenance periods in the Navy’s two CVN-capable public shipyards.¹⁰² When ships are late coming out of maintenance, they have less time for training, which curtailed

101 Eckstein, “Admirals: Fleet Readiness Plan Could Leave Carrier Gaps”; and Gortney, “Predictability and Adaptability: West 2014.”

102 These are Puget Sound Naval Shipyard and Norfolk Naval Shipyard. See Megan Eckstein, “Navy: Half the Carrier Fleet Tied Up in Maintenance, Other 5 Strained to Meet Demands,” *USNI News*, November 4, 2015, available at <http://news.usni.org/2015/11/04/navy-half-the-carrier-fleet-tied-up-in-maintenance-other-5-strained-to-meet-demands>.

the training period for the most recent two CSGs to deploy during 2016.¹⁰³ The first surface combatants entered the OFRP cycle in 2015 and the first carrier in 2016.¹⁰⁴

CONUS-based amphibious ships (LHA/LHD, LPD, LX(R)) operate on a 27-month cycle, which does not provide adequate time to complete maintenance and training between ARG deployments. The Navy intends to lengthen the ARG readiness cycle to address this problem as it did for CSGs with the OFRP.¹⁰⁵

CONUS-based SSNs and P-8 MPAs operate on a 24-month cycle, of which 6 months are spent deployed.¹⁰⁶ For SSNs, this ensures the submarines and crews have adequate time to complete mandatory maintenance and training between deployments. SSBNs and SSGNs use a much higher OPTEMPO cycle of approximately 70-day underway periods followed by 30-day refit periods, during which the ship's Blue and Gold crews turn over.¹⁰⁷

FDNF home-ported overseas use a higher OPTEMPO operating cycle of about 4 months of maintenance and training and 8 months of underway operations each year. This enables FDNF units to achieve about three times the operational availability of a unit in the OFRP cycle. FDNF units should be able to sustain this cycle, in theory, because their higher OPTEMPO enables them to maintain a higher level of proficiency and to require less refresher training each cycle. Moreover, FDNF ships return to CONUS or Hawaii for longer dry dock maintenance periods, which enables their maintenance periods to be shorter when overseas.

The Navy, however, has not followed through with the time and funding to properly maintain its FDNF ships. Thus, these units are often not as ready as their CONUS-based counterparts and are sometimes unable to deploy due to material problems.¹⁰⁸ And although they have a higher OPTEMPO and may be more proficient, FDNF units face highly dynamic threat environments in the Western Pacific and Eastern Mediterranean. Their short post-maintenance training period may not be sufficient to develop and practice new TTPs.

103 Eckstein, "Admirals: Fleet Readiness Plan Could Leave Carrier Gaps."

104 Bruce Lindsey and Heather Quilenderino, "Operationalizing Optimized Fleet Response Plan—SITREP #1," *USNI Blog*, March 5, 2016, available at <https://blog.usni.org/2016/03/05/operationalizing-optimized-fleet-response-plan-sitrep-1>.

105 Matthew M. Burke, "USS Essex Unable to Fulfill Mission for 2nd Time in Seven Months," *Stars and Stripes*, February 1, 2012.

106 Sandra I. Erwin, "Navy 'Fleet Response' Posture Could Strain Shipyards, Crews," *National Defense Magazine*, August 2003, available at http://www.nationaldefensemagazine.org/archive/2003/August/Pages/Navy_Fleet3808.aspx.

107 Butch Hansen, "A New SSBN Operating Cycle for Kings Bay," *Undersea Warfare Magazine* 2, no. 1, Fall 1999, available at http://www.public.navy.mil/subfor/underseawarfaremagazine/Issues/Archives/issue_05/newssbn.html; and Molly Little, "The Challenges and Successes for the Crew of the New SSGN," *Undersea Warfare Magazine*, no. 36, Fall 2007, available at http://www.public.navy.mil/subfor/underseawarfaremagazine/Issues/Archives/issue_36/ChallengesSuccesses.html.

108 U.S. Government Accountability Office (GAO), *Navy Force Structure: Sustainable Plan and Comprehensive Assessment Needed to Mitigate Long-Term Risks to Ships Assigned to Overseas Homeports*, GAO-15-329 (Washington, DC: GAO, May 2015), available at <http://gao.gov/products/GAO-15-329>.

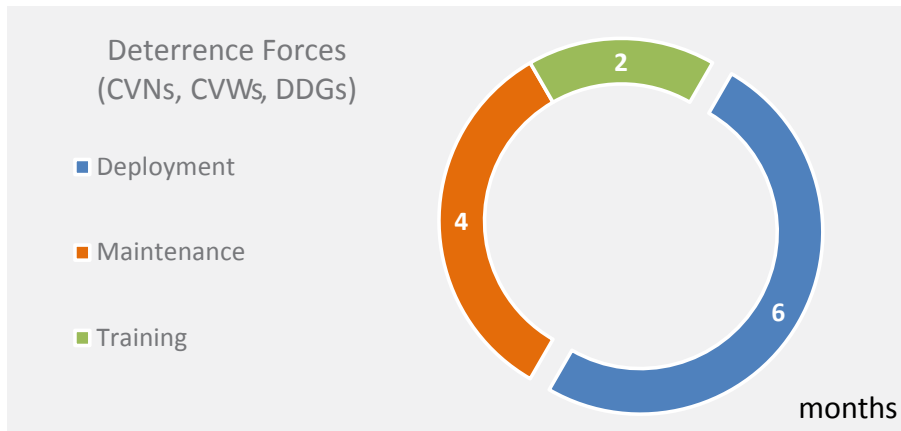
The proposed fleet architecture addresses the shortfalls of today's readiness cycles and improves the ability of fleet units to learn, experiment, and adapt. It also addresses the industrial base capacity needed to support planned readiness cycles.

Deterrence Force

Each region's Deterrence Force will use a higher OPTEMPO readiness cycle akin to the current FDNF cycle, but with less operational time each year to provide more time to complete maintenance and improve training between operational periods. Today CCDRs are attempting to keep the OPTEMPO of FDNF forces below 50 percent for these reasons.

In keeping with today's FDNF, Deterrence Forces would maintain their operational proficiency in large part by their higher OPTEMPO. However, Deterrence Forces would have longer annual training periods and would be focused on a much narrower geography, a smaller set of threats, fewer adversary objectives, and more specific alliance contributions. This would enable each Deterrence Force to become expert on their respective region. Today's FDNF possesses responsibilities throughout a CCDR AOR; the Deterrence Force would more effectively incorporate lessons from recent operations or intelligence assessments into their TTPs, develop and experiment with new operational concepts, and build interoperability and relationships with allies and partners. Figure 48 shows the cycle that would be used by single-crewed units of the Deterrence Force.

FIGURE 48: DETERRENCE FORCE READINESS CYCLE (SINGLE-CREWED UNITS)



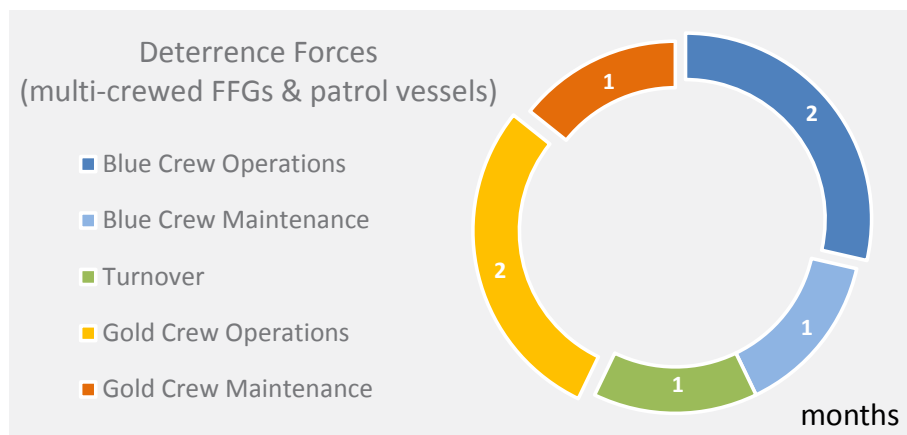
The Deterrence Force would use the cycle detailed in Figure 48 whether they are based overseas or in CONUS. Most of the Deterrence Force in the new fleet architecture would be based or stationed overseas, but some platforms such as SSNs, DDGs, amphibious ships, and CVNs would be based in CONUS or Hawaii due to the space and maintenance challenges associated with overseas home-porting. Patrol aircraft and unmanned vehicle squadrons

would also be based in CONUS with detachments sent overseas as they are today. Specifically, the following Deterrence Force ships would be home-ported in CONUS or Hawaii:

- CVNs for the Northern Europe Deterrence Force
- SSNs that contribute to the Northern Europe, Indian Ocean, and Western Pacific Deterrence Force
- DDGs for the Northern Europe Deterrence Force
- CVLs and amphibious ships for the Mediterranean and Indian Ocean Deterrence Force

Small surface combatants—FFGs and patrol vessels—represent a significant portion of Deterrence Forces and are key components of SAGs and groups for Littoral Combat, Counter-ISR, ASW, and Mining. In the proposed fleet architecture, they would be forward-stationed with rotational crews to maximize their operational availability and reduce the need for them to conduct transoceanic transits. Figure 49 depicts their operational cycle.

FIGURE 49: DETERRENCE FORCE READINESS CYCLE (MULTI-CREWED UNITS)



Submarines and Patrol aircraft in the Deterrence Force would remain in their current 24-month readiness cycles due to maintenance requirements and service life constraints.¹⁰⁹

The larger number of force packages in the proposed architecture will increase the cost and complexity of the readiness cycle. Today's readiness cycle produces only a few (CSG, ARG, etc.) force packages, and thus only needs a few different training and certification processes. The more than a dozen new force packages envisioned by the proposed architecture will require additional training teams, curricula, facilities, and certification events.

¹⁰⁹ For a nuclear-powered ship, a higher OPTEMPO reduces the time between refuelings; if the ship will not be refueled, higher OPTEMPO reduces the life of the ship. *Virginia*-class submarines are not intended to be refueled. Patrol craft have similar limits on the number of flight hours they can operate. A higher OPTEMPO will accelerate the need for replacement.

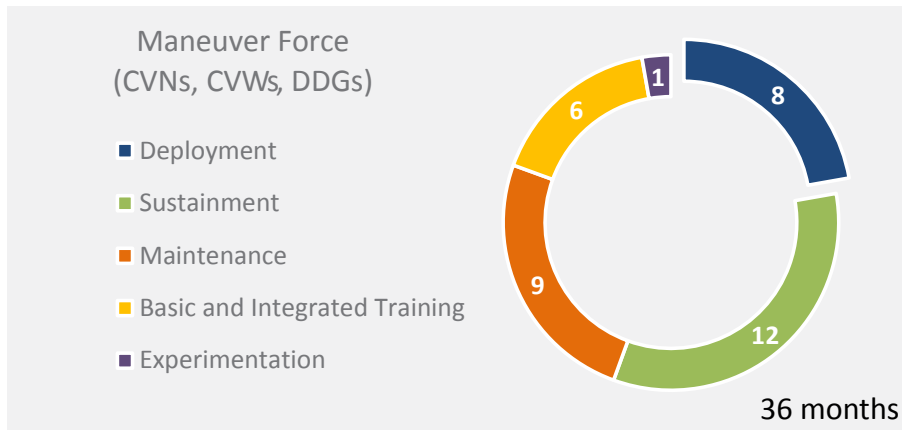
Maneuver Force

Compared to the Deterrence Force, the Maneuver Force will need to be prepared for a wider range of possible operational environments, more potential adversaries, a larger number of alliance relationships, and a higher likelihood of being faced with high-intensity sustained combat. Therefore, it would employ a lower OPTEMPO readiness cycle like today's OFRP to provide more time to prepare for deployment than Deterrence Forces. The Maneuver Force readiness cycle is depicted in Figure 50.

The Maneuver Force would use its longer preparation time before deployment to train for potential operations across the Indo–Asia–Pacific theater. Further, because it would not deploy to a specific region, the Maneuver Force would use its deployed time to:

- Exercise, including multi-carrier operations, near CONUS to establish and improve proficiency for high-end combat against a peer competitor;
- Experiment with new fleet operating concepts;
- Participate in large-scale exercises overseas to improve interoperability and effectiveness with allies and partners; and
- Conduct deterrence (and reassurance) operations such as shows of force or port calls in forward areas to complement Deterrence Forces.

FIGURE 50: MANEUVER FORCE READINESS CYCLE



After deployment, the OFRP cycle would provide opportunities for some of its units to conduct short-surge deployments during the sustainment period following their regular deployment. This period is designed to provide additional capacity for wartime, but today is often used to

fill gaps in carrier coverage.¹¹⁰ As a result, CVNs are more likely to suffer material failures and have less time for maintenance before the next training phase begins. With Deterrence Forces, rather than CSGs, addressing forward operational needs, surge deployments would not be needed to fill gaps in presence. Instead, they could be used strategically to support large-scale exercises or respond to conflict.

The Maneuver Force would be drawn from units based on the U.S. West Coast and the CVN based in Japan. The co-location of most Maneuver Force units would enable them to train and prepare together throughout their readiness cycle.

Maintenance Industrial Base Implications

The new fleet architecture puts more stress on the American ship maintenance industrial base, particularly regarding nuclear-powered CVNs and SSNs. The larger number of SSNs and CVNs poses a potential challenge for the four public shipyards (Norfolk Naval Shipyard, Pearl Harbor Naval Shipyard, Portsmouth Naval Shipyard, and Puget Sound Naval Shipyard) capable of conducting maintenance work on nuclear vessels.

SSNs. *Virginia*-class attack submarines require an approximately 2-year extended dry-docking selected restricted availability (EDSRA) every 10 years and less extensive refits and availabilities every 2 years as part of their readiness cycle. When fully built out, the 66-boat SSN fleet proposed by this fleet architecture would likely require fourteen dry docks to handle the annual demand for SSN EDSRAs and other SSN availabilities. At present, without including dry docks that are CVN-capable or at SSBN refit facilities, public shipyards still have fourteen dry docks that are capable of hosting one—or, in some instances, more—SSNs.

CVNs. Maintaining an additional CVN (for a total of twelve) will require expansion of existing CVN repair infrastructure. Over the past 5 years, the two carrier-sized dry docks in CONUS public shipyards have been almost entirely committed to Dry Docking Planned Incremental Availabilities (DPIA) and Planned Incremental Availabilities (PIA) for today's 11-ship CVN force. This is expected to continue. The CVN construction yard at Newport News, Virginia, which provided surge maintenance capacity in the past, will not be able to support CVN maintenance in the proposed architecture due to continued refueling and complex overhauls (RCOH) of newer *Nimitz*-class CVNs, upcoming carrier inactivations for the oldest *Nimitz*-class CVNs, and expanded CVN construction.

On the West Coast, the Puget Sound Naval Shipyard may require an additional dry dock to accommodate increased West Coast carrier activity for the up to eight Maneuver Force CVNs. Pearl Harbor's CVN-sized dry dock can accept aircraft carriers, but the yard's high cost and small labor pool make it a costlier option than building new or certifying other large dry docks

110 Sam LaGrone, "Carrier USS John C. Stennis Leaves Kitsap-Bremerton for Great Green Fleet Deployment," *USNI News*, January 15, 2016, available at <https://news.usni.org/2016/01/15/carrier-uss-john-c-stennis-leaves-kitsap-bremerton-for-great-green-fleet-deployment>.

on the West Coast. Adding dry docks to existing yards would also help facilitate the efficient use of a likely limited pool of available trained labor. On the East Coast, demand from the three Deterrence Force CVNs could be supported by the existing public yard infrastructure if sufficient labor is available.

Surface combatants. Non-nuclear work associated with the proposed fleet architecture can be accommodated by private shipyards, which will need to grow their workforces to accommodate the tight timelines needed for regular maintenance of Deterrence Force ships. However, the relatively small size and greater frequency of Deterrence Force maintenance packages could “level out” the workload for local ship maintenance yards, facilitate more effective management, and offer a measure of business stability. It could possibly open opportunities for longer-term maintenance agreements.

Unmanned vehicles. Maintenance and sustainment of unmanned vehicles will be an emergent field, likely offering opportunities for smaller members of the maritime industrial base. In particular, treating and classifying these platforms as “weapon systems” rather than vessels would enable them to be maintained overseas or under large multi-platform contracts.

CHAPTER 9

Composition of the Proposed Fleet and Its Implementation

This report proposes a new fleet architecture of 340 ships to enable deterrence and victory at sea. The architecture creates this advantage by enhancing the conventional deterrence afforded by naval forces. The speed with which either country could achieve limited military objectives in their near abroad demands a U.S. naval posture that presents the prospect to China and Russia that their aggression may fail or that they may suffer immediate and unacceptable costs.

To provide this posture, the proposed architecture places platforms and capabilities forward in the Deterrence Force tailored to threats and the likely objectives of potential aggression in each region. Over the horizon in the Indo–Asia–Pacific is the Maneuver Force, which augments the Deterrence Force by waging cross-domain, high-end combat, either to end the conflict or protract it to exploit U.S. advantages in alliance relationships, global power projection, and sustainment.

This study translates the recommended posture into an overall number of ships and aircraft required in the proposed fleet architecture. It assumes that, consistent with the Navy’s current FSA, the rotation base of non-deployed forces in the readiness cycle is sufficient for wartime surge requirements.¹¹¹ The total number of ships needed for each platform type results from the number that are needed deployed overseas multiplied by the number needed in the applicable readiness cycle to maintain one platform forward. For example, in the OFRP cycle, each platform is deployed about 19 percent of the time. Therefore, sustaining one platform forward requires about five platforms total.

111 Note that CLF ships do not have a rotation base, and their wartime surge must be addressed with additional reserve ships. See Arthur H. Barber, “Rethinking the Future Fleet,” *Proceedings*, May 2014, pp. 48–52.

In addition to accounting for the readiness cycle, the architecture must account for the time ships are in transit. Although most of the Deterrence Forces are forward-based or stationed, some platforms such as SSNs, amphibious ships, and CVNs (in Europe) are homeported in CONUS. They may spend 10 to 15 percent of their 6-month deployment in transit to and from their respective regions in Europe and Asia. This “transit tax” will require additional platforms to maintain the same number deployed forward.

The fleet architecture also includes additional platforms to account for the long-term maintenance that takes ships out of their readiness cycle. For example, ships and submarines undergo major maintenance periods such as overhauls every 8–10 years. These periods each last from 1–2 years, so a ship with a 35-year service life will spend 10–20 percent of its life out of the readiness cycle. This constitutes an additional tax on the number of platforms.¹¹²

TABLE 11: COMPOSITION OF THE PROPOSED FLEET¹¹³

	Total Fleet Required
CVN	12
CVL	10
DDG-1000	3
DDG	71
FFG	71
Patrol Vessel	42
SSN	66
SSBN	12
Small Deck Amphibious Ships (LPD, LX(R))	29
Large Oiler (T-AOE)	26
Large Dry Stores Ship (T-AKE)	4
Unmanned Vehicle Support Vessel	14
Afloat Forward Staging Base	2
Large Dry Stores Transport Ship w/VLS	1
Tender	5

112 CVNs are a special case of this tax. A CVN’s mid-life refueling and complex overhaul takes 3–4 years out of its 50-year service life. Therefore, in a fleet of twelve to thirteen CVNs, one CVN will always be in RCOH.

113 The totals at the bottom of this chart use current counting rules or total number of manned ships. The current counting rules do not count ships that do not directly support combat operations, such as sealift ships or hospital ships. The current rules also do not include ships that are not able to move themselves to their deployed area and must instead be carried by a lift ship, such as today’s PC or the proposed patrol vessels. See Department of the Navy, SECNAVINST 5030.8C, p. 2.

Salvage/Fleet Tug	6
Oceanographic Research Ship	5
Command Ship	3
Total Battle Force (using current counting rules)	340
Total Fleet (including patrol vessels)	382
XLUSV	40
XLUUV	40
MQ-4 Detachment (3 A/C)	14
P-8 Detachment (3 A/C)	44
Unmanned Vehicle Squadron	6

Table 11 depicts the proposed fleet architecture with each of these factors considered. It includes 382 manned ships, of which 340 fall under the Navy’s battle force counting rules. Moreover, it includes extra-large unmanned vehicles (XLUSV and XLUUV), and ground-based patrol aircraft. Shipborne aircraft such as CVW aircraft, TERN UAVs, and helicopters are included with the ships on which they would deploy.

Implementing the Proposed Fleet Architecture

The analysis below suggests that the fiscal and industrial base impacts of building the proposed architecture could be manageable. Specifically, the proposed architecture will likely cost about 10–20 percent more to build, operate, and sustain than the Navy’s planned fleet, and the shipbuilding industrial base could reach the objective number for each ship type of the proposed fleet architecture in the 2030s.

The Navy will need to modify its shipbuilding plans to reach the size and composition of the proposed fleet architecture. The alternative shipbuilding plan described below will cost an average of \$23.2 billion per year, 18 percent more than the \$19.7 billion annual cost of the draft 30-year shipbuilding plan associated with PB17.¹¹⁴ If the Navy expands the CLF fleet to meet the wartime demands of the proposed fleet architecture, the average annual cost rises to \$23.6 billion, 20 percent greater than the PB17 plan. The O&M costs associated with the proposed fleet architecture plan will cost an average of \$16.5 billion per year, 14 percent more than the \$14.6 billion associated with the PB17 budget.¹¹⁵

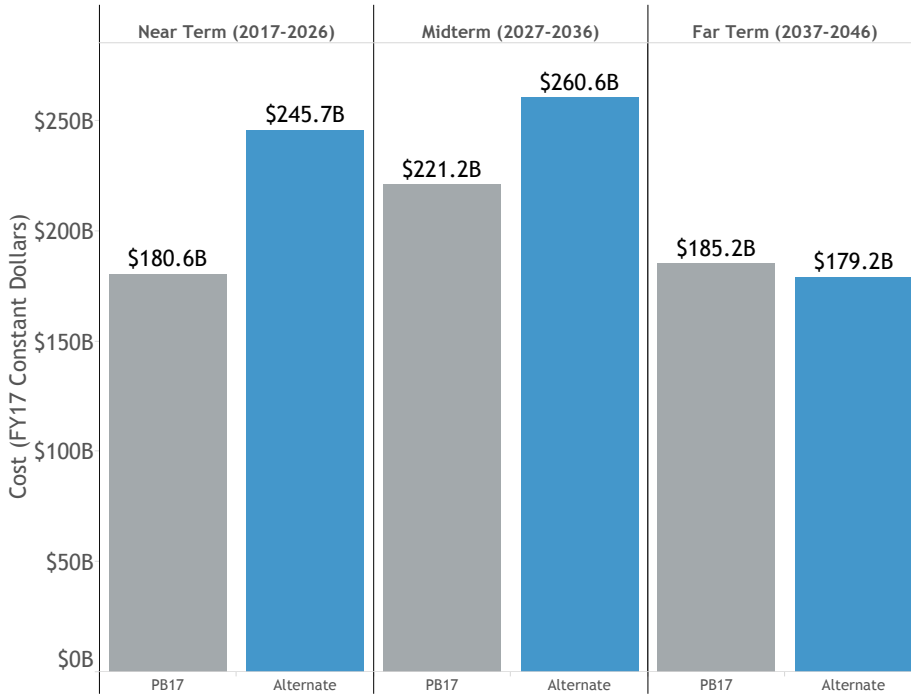
The alternative shipbuilding budget depicted in Figure 51 balances the need to reach the proposed architecture with the imperative to manage costs. For many ship types, the plan assumes that existing platforms, with modest modification, will support the new operational

114 CNO, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2017*, p. 7.

115 For more information regarding the calculations, see Appendix A.

concepts of the proposed architecture. The plan replaces these platforms at the end of their service lives with new, purpose-built ships and aircraft designed for their missions in the new architecture.

FIGURE 51: SHIPBUILDING COSTS FOR PROPOSED ARCHITECTURE

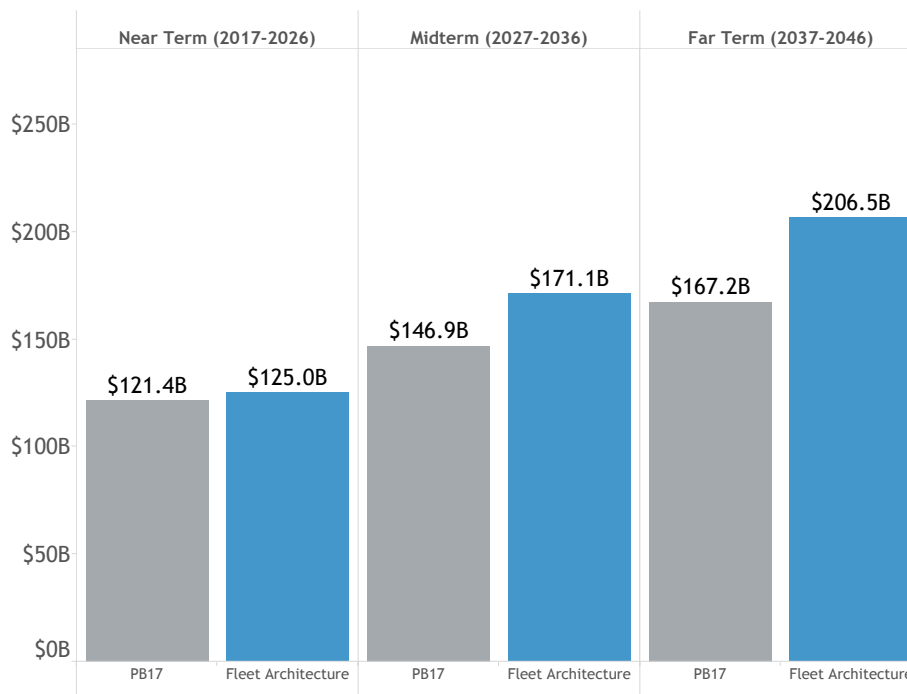


For procurement, the largest cost difference between the alternative shipbuilding plan and the PB17 plan occurs in the first two decades of its implementation. Between 2017 and 2036, the alternative plan calls for the Navy to spend \$103 billion more on shipbuilding than is projected in the PB17 plan—mostly to build up the fleet’s SSN and FFG inventories. From 2037 to 2046, the alternative plan is \$6 billion cheaper than the PB17 plan due to the PB17 plan’s large programmed purchases of surface combatants to replace LCSs and DDGs. Because it established higher inventories in the first two decades, the alternative plan can sustain low-rate construction of surface combatants and does not require a large recapitalization between 2037 and 2046.

For O&M, the largest difference in cost between the alternative plan and the PB17 plan occurs in the last two decades of implementation. Between 2027 and 2046, the alternative plan requires the Navy to spend an extra \$57 billion dollars to operate and maintain the fleet, mainly due to costs associated with larger numbers of small surface combatants, SSNs, and T-AOEs. From 2017 to 2026, the alternative plan is only 2 percent more expensive than the PB17 plan because many of the new ships required for the proposed architecture have not yet reached the fleet.

The O&M cost estimates in Figure 52 are only for normal operations of the fleet architecture described in Table 11. They do not account for changes in O&M costing due to revised deployment cycles, changes in posture, or modifications made to existing ships that could increase sustainment costs.

FIGURE 52: O&M COSTS FOR PROPOSED ARCHITECTURE



In addition to the above baseline alternative shipbuilding plan, this study examined three excursions to explore the impacts of other potential shipbuilding strategies, described in Table 12:

- A plan that sustains SSN procurement for an extended period at a rate of three per year due to industrial base or cost constraints;
- A plan that includes a build-up to the full wartime CLF requirement rather than the peacetime requirement.
- A plan that comes as close as possible to meeting the requirements of the proposed fleet architecture while keeping the overall cost increase to just 5 percent.

TABLE 12: SHIPBUILDING PLAN EXCURSIONS

	PB17 Shipbuilding Plan	Alternative Shipbuilding Plan	Alternative Plan: 3/year SSN Excursion	Alternative Plan: CLF Excursion	Alternative Plan: Low Cost Excursion
Maximum Submarine Build Rate	2/year	4/year	3/year	4/year	2/year
Meets 66 SSN Requirement?	No	Yes (2035–)	Yes (2042–)	Yes (2035–)	No
CVN Procurement Cycle	5 years	4 years	4 years	4 years	5 years
Meets 13 CVN Requirement by 2030s?	No	No	No	No	No
Meets Wartime CLF Requirement?	No	No	No	Yes (2039–)	No
Average Annual Cost (FY17 \$)	\$19.7B	\$23.2B	\$23.1B	\$23.6B	\$20.5B
Percent Greater Than PB17 Plan	n/a	18%	17%	20%	4%

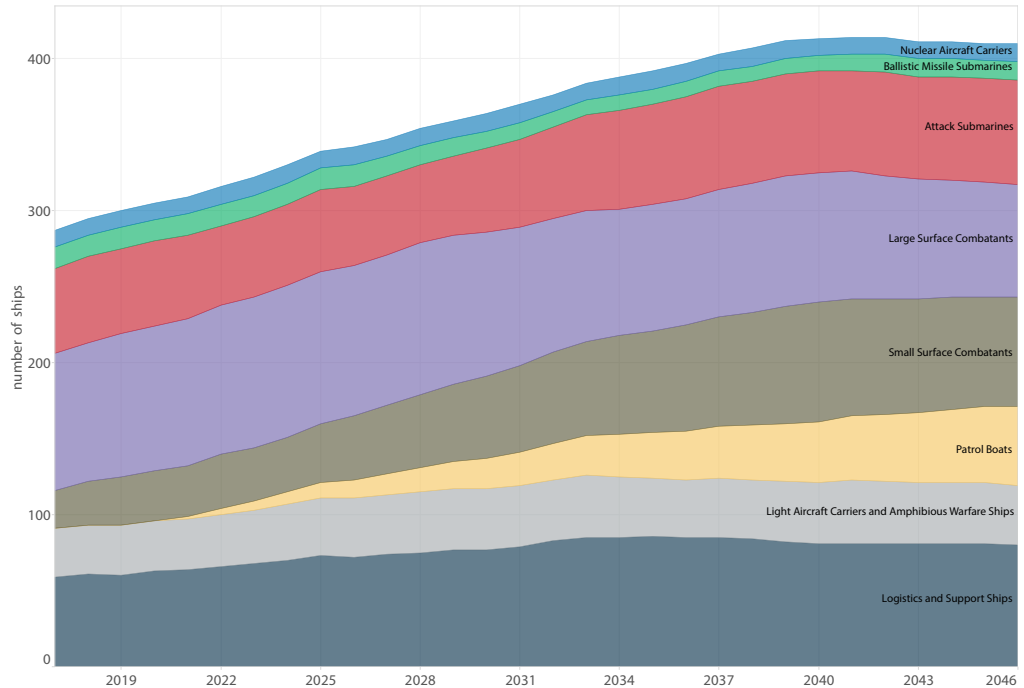
The SSN and CLF excursions are described in more detail in the sections on those ship classes below. The low-cost excursion would average \$20.5 billion per year and mirror the alternative shipbuilding plan proposed by this study save for the acquisition of three fewer aircraft carriers and fourteen fewer SSNs over the next 30 years, resulting in an SSN procurement schedule identical to that of the PB17 shipbuilding plan (see Table 12).

The new architecture will be more expensive to procure and maintain than today's fleet, but this may be the price the United States must pay to compete with other great powers in the 2030s. If great power competitions do not develop as described in Chapter 2, however, some aspects of the proposed architecture could be modified. For example, if China lowers its level of assertiveness or aggression in the East and South China Seas, the Deterrence Force posture in those regions could be reduced, lowering the construction requirements for SSNs, amphibious ships, and small surface combatants. This would also reduce O&M costs in the out-years once those additional ships would have reached the fleet. The long lead time for ship construction enables a deliberate process of assessment to inform the degree to which this architecture needs to be implemented.

Ship Construction by Ship Type

The alternative shipbuilding plan, depicted in Figure 53, will lead to a battle force that meets the force structure requirements of the new fleet architecture by 2040, although CVN inventory periodically falls below the 12-ship requirement. Specifics related to each major ship type are addressed below.

FIGURE 53: BATTLE FORCE INVENTORY RESULTING THE ALTERNATIVE SHIPBUILDING PLAN



Nuclear Aircraft Carriers¹¹⁶

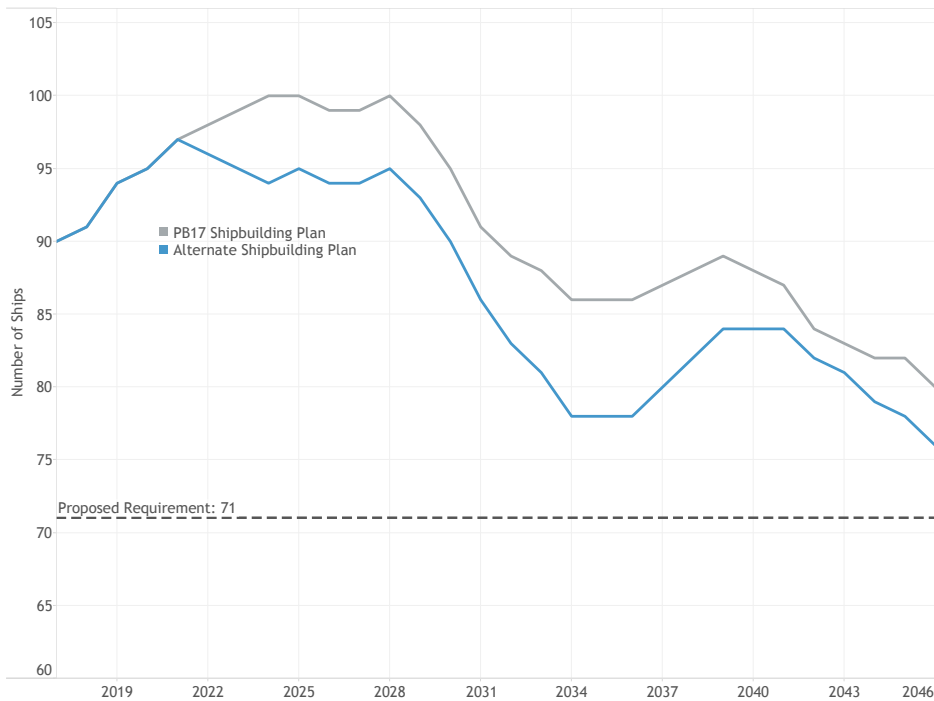
To support the requirement for twelve CVNs in the new fleet architecture, the alternative shipbuilding plan accelerates carrier procurement from a rate of one ship every 5 years to one ship every 4 years. Consequently, between 2017 and 2046, the alternative plan calls for the Navy to procure eight aircraft carriers rather than the six programmed in the PB17 plan. Despite this higher procurement rate, the alternative plan only allows the Navy to maintain a 12-carrier fleet sporadically over three decades.

¹¹⁶ The alternative shipbuilding plans do not include costs for additional RCOHs associated with a larger fleet of CVNs.

Large Surface Combatants

The alternative shipbuilding plan calls for procurement of fifty-seven DDGs between 2017 and 2046 compared to sixty-six in the Navy’s PB17 shipbuilding plan, as shown in Figure 54. It mirrors the PB17 plan by procuring *Arleigh Burke*-class DDGs through 2029 before switching to a new class of DDG in 2030. The procurement rate of these new destroyers is slower in the alternative plan than in the PB17 plan, which reflects the proposed fleet architecture’s greater emphasis on the use of small surface combatants over large surface combatants.

FIGURE 54: LARGE SURFACE COMBATANT INVENTORY UNDER THE ALTERNATIVE SHIPBUILDING PLAN

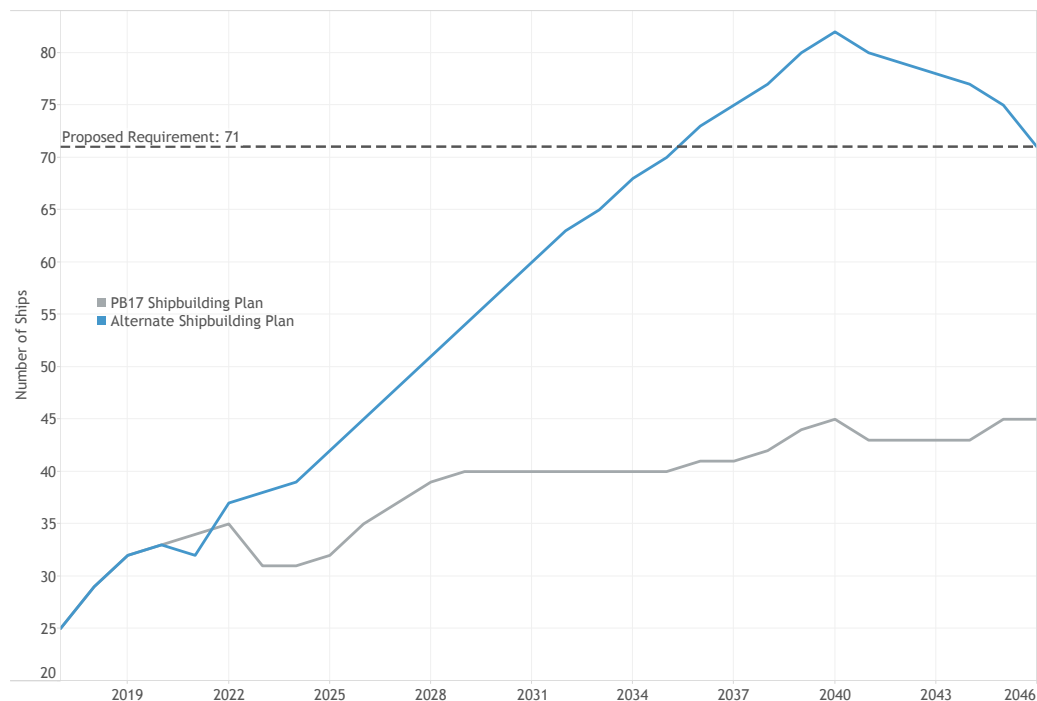


Small Surface Combatants

The PB17 shipbuilding plan includes procurement of fifty-eight small surface combatants (SSC): Three LCSs, eleven LCSs modified as frigates, and forty-four future SSCs. The alternative shipbuilding plan, depicted in Figure 55, halts the procurement of all three types of ships in 2020 and replaces them with an FFG that has a lead ship cost of \$879 million. The alternative plan procures the FFG at a rate of two per year between 2020 and 2022 to enable the industrial base to manage the learning curve for a new ship class. Production then rises to three per year until 2042, resulting in a total purchase of seventy-three ships. This results in the requirement of seventy-one ships being met in 2037.

The alternative shipbuilding plan also includes the procurement of a patrol vessel with capabilities like the VT Halper-Marine *Ambassador* Mk III fast missile craft. The lead ship cost of the patrol vessel is \$322 million, and the plan procures the vessel at a rate of two per year from 2019 onwards.

FIGURE 55: SMALL SURFACE COMBATANT INVENTORY UNDER THE ALTERNATIVE SHIPBUILDING PLAN



Submarines

To meet the new architecture's requirement of sixty-six attack submarines, the alternative shipbuilding plan calls for the procurement of sixty-two SSNs, compared with forty-four SSNs in the PB17 plan. To achieve this higher total, the alternative plan increases the rate of submarine production from the current schedule of two per year to three per year in 2020 and four per year from 2021 to 2028. After 2028, the plan calls for the rate to decrease until the 2040s when procurement stabilizes at three submarines every 2 years.

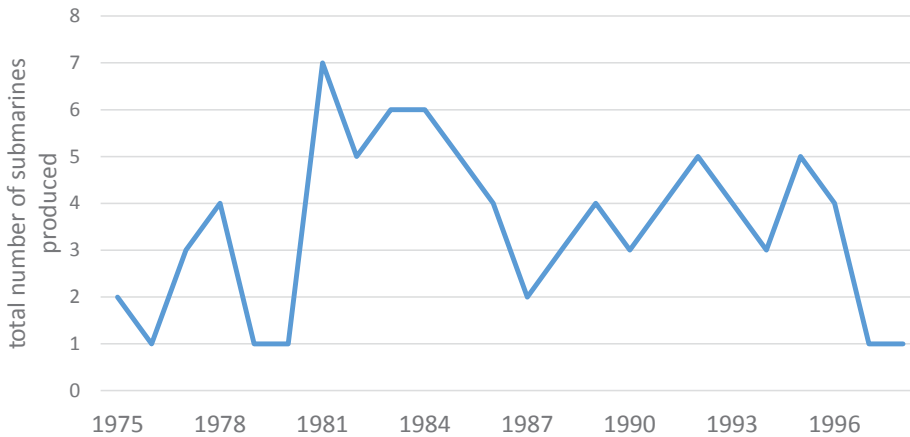
This study also examined an excursion that only raised the rate of production to a maximum of three submarines per year. Table 13 and Figure 57 show the alternative shipbuilding plan and excursions.

TABLE 13: SUBMARINE CONSTRUCTION EXCURSIONS

	2017–2026	2027–2036	2037–2046	Average Annual Submarine Procurement Cost
Submarines procured: 4/year max rate	39	24	15	\$10B
Submarines procured: 3/year max rate	31	30	15	\$9.8B
Submarines procured: PB17 plan	20	20	16	\$8.3B

Although U.S. submarine builders have not produced submarines at a rate of more than two per year for over a decade, General Dynamics’ Electric Boat Division in Groton and Huntington Ingalls’ Newport News Shipbuilding historically completed submarines at rates as high as seven per year, as depicted in Figure 56.¹¹⁷ A 2004 Congressional Research Service (CRS) report concluded that neither shipyard had made any significant changes, such as selling land, which would preclude the yards from increasing submarine production to a rate of four per year or more.¹¹⁸

FIGURE 56: U.S. SUBMARINE PRODUCTION 1975–1998



Source: RAND Corporation, Submarine Production 1975–1998

The submarine supplier industrial base would be less able to absorb a rate increase than the shipyards. Some amount of lead time and up-front investment would be necessary to avoid scheduling delays if the Navy adopts a construction rate of three or more submarines per

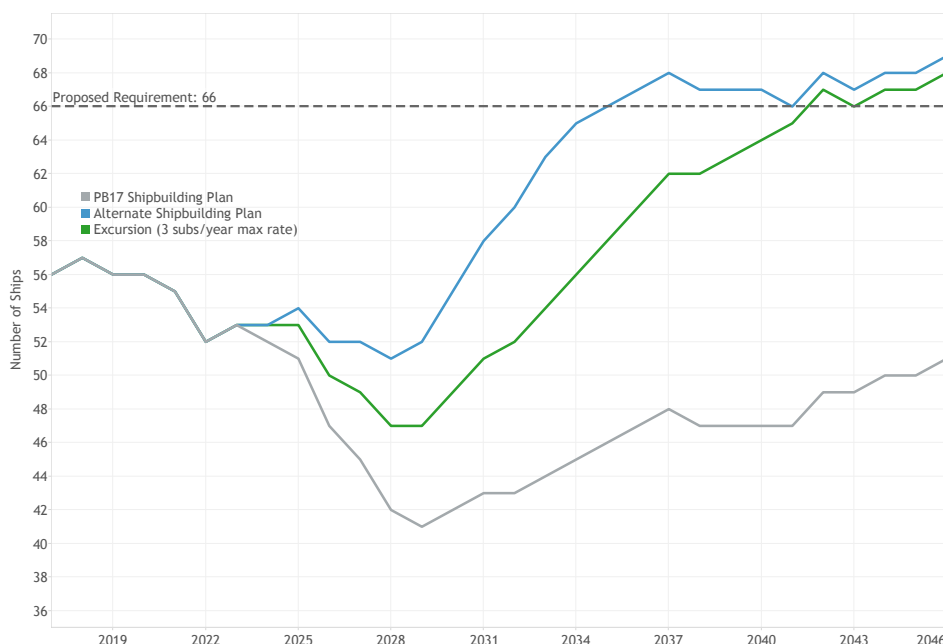
117 John Birkler et al., *The U.S. Submarine Production Base: An Analysis of Cost, Schedule, and Risk for Selected Force Structures*, MR-456-OSD (Santa Monica, CA: RAND Corporation, 1994), p. 2.

118 Ronald O'Rourke, *Navy Attack Submarine Force-Level Goal and Procurement Rate: Background and Issues for Congress*, RL32418 (Washington, DC: CRS, as updated July 30, 2004), pp. 43–44.

year.¹¹⁹ Accordingly, based on estimates from CRS, the plans in this report include an additional \$132 million in spending to raise the maximum annual submarine construction to three and \$263 million to raise it to four. In addition, the shipbuilding plans delay the rate increases for several years to provide time to prepare the industrial base.

The alternative shipbuilding plans do not modify the PB17 procurement schedule of the *Columbia*-class SSBN, which will deliver twelve SSBNs between 2028 and 2042.

FIGURE 57: SSN INVENTORY UNDER THE ALTERNATIVE SHIPBUILDING PLAN



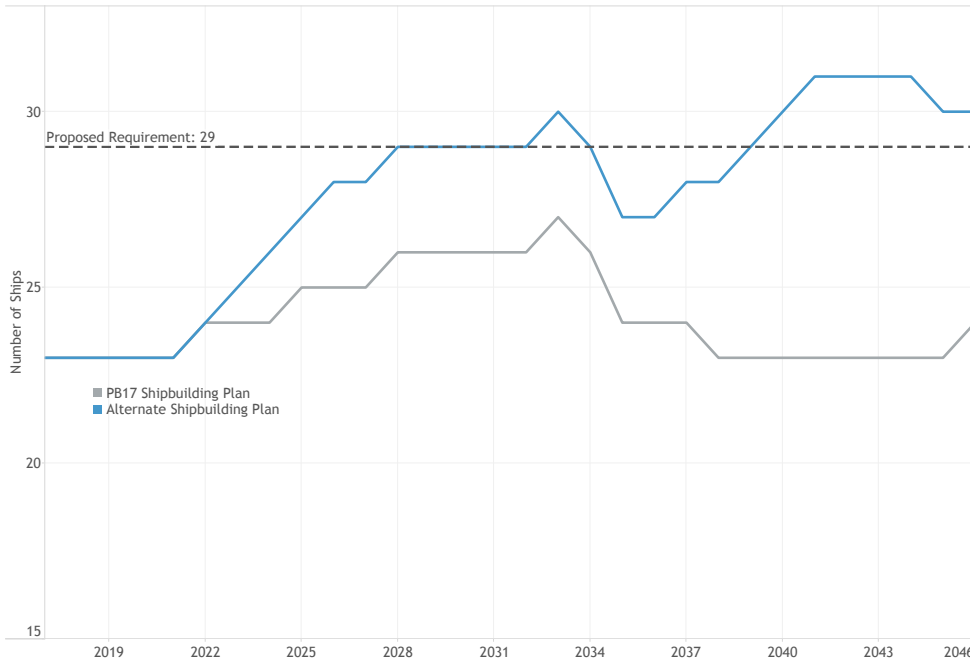
Light Carriers and Amphibious Ships

To sustain the requirement for ten CVLs, the alternative shipbuilding plan includes three LHAs and four CVLs procured at the same rate as the seven LHAs in the PB17 plan. The CVL’s lead ship cost of \$6 billion is 55 percent greater than the LHA due to the CVL’s larger displacement and the addition of two Electromagnetic Aircraft Launch System (EMALS) catapults.

The alternative plan raises the total number of smaller amphibious ships procured to twenty-five from the sixteen in the PB17 plan. As shown in Figure 58, the alternative plan begins procurement of the LX(R) in 2017 rather than in 2020, as in the PB17 plan, and maintains that procurement for an additional 5 years until 2036. The alternative plan delays the initial procurement of the replacement for the LPD-17 until 2042, 2 years after the PB17 plan.

119 Ibid., pp. 46–47.

FIGURE 58: LPD AND LX(R) INVENTORY UNDER THE ALTERNATIVE SHIPBUILDING PLAN



Logistics and Support Ships

The alternative shipbuilding plan adds a new ship type, the combat support ship (T-AOE), to the CLF in place of the *John Lewis*-class T-AO 205. The estimated lead ship cost of the new-build T-AOEs is \$770 million, about 10 percent greater than the T-AO 205. This is to account for modifications that would enable it to carry ammunition as well as fuel and petroleum products.

The alternative plan includes the procurement of both submarine and unmanned vehicle tenders. They use a common 10,000-ton (light) hull form with the lead ship cost of the 21,000-ton submarine tender estimated at \$377 million and the 15,000-ton unmanned vehicle tender estimated at \$270 million.

This study also examined the impact of acquiring a logistics fleet sized to meet wartime demand rather than merely maintain a peacetime presence. The wartime excursion, shown in Table 14, accounts for a 12-ship increase in the requirement for T-AOE and a 14-ship increase in the requirement for T-AKE. Procuring these additional T-AOEs and T-AKEs would raise shipbuilding spending by \$12 billion over the 30-year span of the shipbuilding plan, or about \$400 million per year.

The plan does not consider costs for acquiring and/or leasing additional T-AOT tankers or acquiring additional T-AK cargo ships¹²⁰

TABLE 14: CLF CONSTRUCTION EXCURSIONS

	2017–2026	2027–2036	2037–2046	Overall Average Annual Cost of all shipbuilding
CLF Procured: peacetime only	16	10	0	\$23.2B
CLF Procured: peacetime and wartime	21	20	5	\$23.6B

Summary

The alternative shipbuilding plan described above would allow the Navy’s fleet to grow to meet all the requirements of the proposed fleet architecture by 2040 with two caveats. If submarines are only procured at three SSNs per year, the inventory will not reach the 66-ship requirement until after 2040, and CVN inventory fluctuates between eleven and twelve for most of the 30-year plan.

The overall cost increases for ship construction and O&M of the proposed fleet architecture are 10 to 20 percent higher than the Navy’s current plans. This may be affordable, but other demands on federal resources may preclude this level of increase in Navy spending. The size of the proposed fleet could be reduced in some ship classes by accepting some reasonable risk in the ability of naval forces to deter great power aggression. For example, if Russia does not continue to improve its military or begins to recede as a geopolitical competitor, the Deterrence Forces in Northern Europe and the Mediterranean may be reduced. This could allow slower CVN, SSN, and FFG construction in the near term and reduce resulting O&M costs in the out-years when those additional ships would have reached the fleet.

Because ship construction takes years and evolving the fleet takes decades, there is time to evaluate the risk of emerging great power competitions and decide how the fleet’s design should evolve in anticipation of future needs for naval forces.

¹²⁰ While ten T-AK are resident in the Maritime Prepositioning Ship (MPS) program, they are currently tasked with storing U.S. Marine Corps vehicles, equipment, and ammunition. Consequently, either some of these would need to be reprioritized to support Navy resupply and/or additional T-AK would need to be constructed. One T-AOT is also currently in the MPS program. Therefore, additional T-AOT would need to be acquired or leased from industry.

CHAPTER 10

Conclusion and Recommendations

The Navy will need a new fleet architecture to enable the deterrence of aggression by great power competitors by the 2030s. The militaries of Russia and China will likely continue to improve their capability and proficiency, enabling them to pursue territorial ambitions in their near abroad—for example, Russia’s in the Baltic NATO allies or China’s in the Senkaku Islands. If they successfully achieve those objectives, America’s security assurances will lose credibility, and U.S. alliances will suffer. If great powers pursue aggression, and U.S. forces cannot defeat them or control escalation, the ensuing great power conflict could have disastrous global consequences. The United States must deter these conflicts rather than fight them to protect worldwide economic and political systems.

The fleet architecture proposed by this study will support a new posture for U.S. forces designed to deny and punish great power aggression using new operating concepts resulting from a combination of emerging technologies and new methods of achieving warfighting objectives. To implement these operating concepts, U.S. naval forces will need new force packages, platforms, weapons, and sensors and to sustain the required overseas posture. They will also need to employ new basing arrangements and modified readiness cycles.

To establish this fleet architecture by the 2030s, when future CCDRs and national leaders will need it, the Navy should pursue the following initiatives detailed in this report:

- Focus Navy force development strategy on future competitions. The Navy’s Strategic Plans and related documents used to guide budget development emphasize current concerns or success in canonical large-scale warfighting scenarios. Instead of conducting major combat operations or fighting terrorists, future naval forces will be needed as the front line for steady-state deterrence of great powers; this should drive naval force development decisions over the next decade.

- Identify a new overarching strategic concept for how U.S. naval forces address great power competitors. Today's maritime strategy directs a wide range of naval responsibilities and does not establish the most important responsibilities of naval forces and how, overall, these responsibilities should be pursued. This study argues deterring great power conflicts should be the overarching responsibility of naval forces, and they must pursue that objective through a denial and punishment approach to deterrence.
- Develop new doctrine and requirements for new warfighting concepts. The Navy's current approaches to important missions such as ASW, AMD, and SUW still reflect an expectation that operating environments will be relatively permissive and that naval missions will be conducted in the context of large-scale campaigns after all the required forces have flowed to theater. The short, sharp conflicts great power adversaries may pursue will require naval forces be able to quickly respond and defeat the aggression.
- Begin establishing new force packages that can execute current and future warfighting concepts. The small menu of force packages supported by today's FRTP are efficient to train and certify but do not support the new ways of operating that will be necessary in the future against great powers and highly capable regional powers. The Navy's current effort to prepare and deploy SAGs for SUW operations in the Pacific is a good start toward expanding the range of force packages and better aligning them with new operating concepts.
- Prioritize weapons and sensor development to support new operating concepts. The operating concepts needed to deter and fight great power competitors require new or modified weapons that enable distributed operations by smaller forces in contested areas and exploit the effectiveness of mission kills or suppression of enemy operations in denying aggression. Some of the Navy's current efforts are still oriented toward operations in relatively permissive environments by large, concentrated groups of forces.
- Implement basing changes that will support a posture that will help deter great power aggression. The key to deterring great power competitors in the future is an effective naval posture, because naval forces can be positioned near the objectives of great power aggressors and are less subject to concerns or coercion of allied host nations in the region. The Navy and CCDRs are working on some of these changes already, but it is unclear if their initiatives reflect a strategic approach to improving future posture in specific ways.
- Revise the Navy's readiness processes to improve the ability of naval forces to learn and adapt. The Navy's current training plans do not afford the time or focus needed to develop and implement new approaches to address changing adversary capabilities and objectives. The Navy will need to tailor training and preparations for deployment to what forces are likely to encounter. This will need to be complemented by more tailored deployments that ensure deployed forces are focused on the region and operations for which they were prepared.

- Evolve shipbuilding plans to create a fleet better able to deter great power aggression. The Navy could develop a more effective fleet within the constraints imposed by current budget caps. As described in Chapter 9, even a shipbuilding budget that is only 4 percent larger would enable the construction of additional LX(R)s, small surface combatants, and extra-large unmanned vehicles that would dramatically improve the conventional deterrence capability of deployed naval forces by implementing new operating concepts for key missions in contested areas.

Next Steps

The fleet architecture described in this report depicts a naval force that trains, deploys, operates, and is postured very differently than today's fleet. It is also larger and integrates new types of platforms, capabilities, and units. Several significant implications of this new architecture will need to be addressed in subsequent analyses.

Most significantly, the new fleet architecture is more expensive than today's fleet. As described in Chapter 9, ship construction and O&M costs for the proposed fleet will be greater than those of the Navy's planned fleet. New and additional aircraft in the CVL and CVN air wings will increase costs for aviation procurement. And more sailors will be required to operate this larger fleet, which will increase manpower costs. These costs will need to be evaluated with more fidelity.

The operational relationship between the Navy and Marine Corps will change as a result of this proposed architecture, which reflects new operational concepts for amphibious operations being developed by the Marine Corps.¹²¹ Small amphibious ships will be equipped with offensive SUW systems and more robust air defenses, enabling them to operate both as traditional amphibious ships and as surface combatants. Some of the current roles played by large deck amphibious assault ships will shift to small amphibious ships as LHA/LHDs become CVLs. Marines and sailors on CVLs will support small-scale strikes and SUW to a greater degree, as opposed to only conducting amphibious operations. Moreover, the fielding of a light aircraft carrier will enable a wide range of new operational concepts for naval aviation that should be studied.

The proposed architecture changes the relationship between manned and unmanned systems. It incorporates XLUUVs and XLUSVs in place of manned platforms to carry sensors, deploy smaller unmanned vehicles, conduct decoy and jamming operations, or deploy weapons. Although operators will still be able to control the use of weapons, the families of UUVs, USVs, and UAVs envisioned in this architecture will expand the reach and persistence of U.S. forces in ways that assume realistic levels of technological advancement compared to today. New operational concepts employing manned and unmanned systems should be further evaluated and refined.

121 Eckstein, "Navy and Marines Developing New CONOPs for Contested Littoral Operations."

Implementing the new architecture will require changes to the relationship between the Navy and the defense industrial base. In theory, the shipbuilding plan described in Chapter 9 is executable by today's shipyards. Building the equipment and systems for these ships, however, will be a significant challenge. Second- and third-tier suppliers do not necessarily have the continuous orders to remain able to build military systems. When orders stop for a new sensor or weapon, they move on to another system or leave the defense business entirely. Today's supplier base is sized, as a result, to efficiently produce the systems needed. The Navy may need to pay a premium to ramp up capacity in the supplier industrial base.

This fleet architecture does not incorporate detailed assessments of military risk. It assumes overseas posture and presence will drive overall fleet size requirements, as it does today, and evaluates that size force to be able to address the surge warfighting needs CCDRs anticipate in their plans. A more detailed analysis using modeling and simulation could identify ways in which the fleet architecture could accept additional risk, which could reduce force levels and the resources necessary to acquire this architecture.

One method of assuming additional risk is to envision an architecture with a greater degree of reliable networking, communications, and C2. This report's architecture enables a graceful degradation of command and control to a point at which Deterrence Forces are operating under mission command orders and using line-of-sight communications. Assuming a greater degree of reliability in C2 networks could result in a somewhat smaller—but more effectively networked—force structure: a force structure that would be viewed as less “platform-centric” than the one advanced in this report.

In Conclusion

Today's Navy emphasizes efficiency over effectiveness. This was a rational reaction to the presumed end of great power competition with the fall of the Soviet Union. In the decades that followed, the U.S. Navy pursued a deterrence posture that relied on modest levels of forward deployed forces that were smaller representations of the larger force. To avoid instability caused by regional powers, deterrence was premised on the promise of punishment that would arrive with follow-on forces.

This approach to conventional deterrence will likely not work against the potential great power aggressors of the 2030s, who are likely to seek the ability to achieve a quick, decisive victory over adversaries. Efforts to reverse the results of aggression would require a much larger conflict and would likely have global consequences that would create international pressure to reach a quick settlement.

To be deterred in the 2030s, aggressors must be presented with the possibility that their goals will be denied or that the immediate costs to pursue them will be prohibitively high. The architecture proposed by this report would achieve that effect with a more powerful day-to-day Deterrence Force tailored by region. Bolstering that immediate deterrent would be the Maneuver Force, which in peacetime would hone its skills in multi-carrier, cross-domain,

high-end warfare. These two forces would be comprised of some of the same elements, but packaged and supported differently.

This proposed fleet architecture emphasizes effectiveness over efficiency. Built on new operating concepts the Navy is already pursuing and incorporating a new approach to conventional deterrence, the new architecture offers the prospect of protecting and sustaining America's security and prosperity, and that of our friends and allies around the world, in the decades ahead. Deterring great power war demands the readiness to contest and win it, and a fleet that supports this approach.

APPENDIX A

Cost Estimation Methodology for Shipbuilding

To evaluate the feasibility of our recommended fleet architecture, this study includes estimates of the cost of new ship construction and O&M for both the Navy's PB17 shipbuilding plan and CSBA's recommended shipbuilding plan.

Ship Construction Estimates

For existing platforms, CSBA estimates began with the lead-ship cost of a given class as reported in the Navy's annual budget documentation. From there, CSBA factored in three different variables to arrive at the cost of future ships of the same class: learning rate, shipbuilding rate, and shipbuilding inflation.

The learning rate is a measure of how much the cost of manufacturing and construction is reduced as shipbuilders gain experience and introduce efficiencies over the course of a production run. CSBA used the classic learning curve model for estimating cumulative learning, sometimes referred to as Wright's Learning Model in honor of its developer, U.S. aeronautical engineer T. P. Wright.

$$Y_n = Y_1 n^b$$

Where:

Y_n = The cost of the n^{th} unit

Y_1 = The cost of the first unit

n = The cumulative number of units

b = The slope coefficient, or $\text{Log}(\text{rate of learning})/\text{Log}(2)$

CSBA estimated a learning curve based on existing data and the FY16 analysis of shipbuilding plans published by the CBO for ships already in production runs. Where detailed unit cost information was not available, CSBA employed a default learning rate of 90 percent.

CSBA also assumed that cost reductions would be gained by the concurrent production of multiple ships of the same type because shipyards would be able to better plan their procurement of labor and raw materials. CSBA derived its shipbuilding rate cost reductions from the CBO's historical observations: a 20 percent decrease in unit cost for surface ship purchases of two or more and a 10 percent decrease in unit costs for submarine purchases of two or more.

Finally, CSBA accounted for the difference in the cost growth between shipbuilding and the rest of the U.S. economy. According to the CBO, the difference between the GDP price index and the Navy's shipbuilding costs has been roughly 1.3 percentage points per year over the

last 31 years. CSBA assumed that this same 1.3 percentage point difference would continue through 2046, the final year projected in the study.

In order to estimate the costs of new ship classes, CSBA used an analogous current platform to determine a cost per thousand tons (fully loaded). For example, when estimating the lead ship cost of a new large surface combatant (LSC), CSBA used as its baseline the DDG-51. The cost of the first DDG-51 was \$3.12 billion in 2017 dollars, and the ship displaced 8,900 tons fully loaded. The cost per thousand tons is therefore \$351 million, and the lead ship cost of a 12,000-ton LSC would be \$4.21 billion.

Operations & Maintenance Estimates

To estimate the O&M costs of the alternative shipbuilding plan and the FY17 shipbuilding plan, CSBA first identified the average annual O&M cost per ship type using three different methodologies:

1. For existing ships, CSBA used the last 15 years of data contained in the Naval Visibility and Management of Operating and Support Costs (VAMOSC) Ships database and the Military Sealift Command database. CSBA averaged the O&M costs for each ship class from 2001 to 2015 in constant year 2017 dollars.
2. For ships that are in development but have not yet been introduced into service, CSBA used the annual O&M cost projections contained in the December 2015 DoD Selected Acquisition Reports (SARs).
3. For entirely new ships, CSBA used the annual O&M costs of an analogous vessel that is already in the fleet. CSBA assumed that new ship O&M costs would mirror the entire life cycle of an analogous ship, rather than only the last 15 years. Thus, CSBA averaged the O&M costs of an analogous ship from 1984 to 2015 in constant year 2017 dollars.

To identify the rate at which O&M costs would grow over time, CSBA used the VAMOSC Ships database to calculate the difference between O&M cost growth and GDP price index for the entire fleet from 1984 to 2015. CSBA then averaged those rates to identify a fleet-wide O&M cost growth rate of 2 percent.

CSBA applied the O&M cost growth rate to annual O&M cost estimates to arrive at the total O&M cost for each type of ship over the 30-year span of the shipbuilding plan.

APPENDIX B

Combat Logistics Force Assessment Methodologies

This study conducted peacetime and wartime assessments that informed the shaping, sizing, and posture of the CLF. The methodologies used for both the peacetime and wartime assessments are based on the methodologies and models employed by CNA in the 2011 T-AO(X) Analysis of Alternatives, with a few noted deviations, especially to account for CONSOL tanker refueling and T-AK reloading.

APPENDIX C

Legislation Requiring Fleet Architecture Studies

National Defense Authorization Act for Fiscal Year 2016, P.L. 114-92, 129 Stat. 726 (2015), Section 1067, Studies of Fleet Platform Architectures for the Navy.

SEC 1067. STUDIES OF FLEET PLATFORM ARCHITECTURES FOR THE NAVY

(a) INDEPENDENT STUDIES.

(1) IN GENERAL. The Secretary of Defense shall provide for the performance of three independent studies of alternative future fleet platform architectures for the Navy in the 2030 timeframe.

(2) SUBMISSION TO CONGRESS. Not later than April 1, 2016, the Secretary shall submit the results of each study to the congressional defense committees.

(3) FORM. Each such study shall be submitted in unclassified form, but may contain a classified annex as necessary.

(b) ENTITIES TO PERFORM STUDIES. The Secretary of Defense shall provide for the studies under subsection (a) to be performed as follows:

(1) One study shall be performed by the Department of the Navy and shall include participants from

(A) the Office of Net Assessment within the Office of the Secretary of Defense; and

(B) the Naval Surface Warfare Center Dahlgren Division.

(2) The second study shall be performed by a federally funded research and development center.

(3) The final study shall be conducted by an independent, non-governmental institute which is described in section 501(c)(3) of the Internal Revenue Code of 1986, and exempt from tax under section 501(a) of such Code, and has recognized credentials and expertise in national security and military affairs.

(c) PERFORMANCE OF STUDIES.

(1) INDEPENDENT PERFORMANCE. The Secretary of Defense shall require the three studies under this section to be conducted independently of each other. H. R. 1735 267

(2) MATTERS TO BE CONSIDERED. In performing a study under this section, the organization performing the study, while being aware of the current and projected fleet

platform architectures, shall not be limited by the current or projected fleet platform architecture and shall consider the following matters:

- (A) The National Security Strategy of the United States.
- (B) Potential future threats to the United States and to United States naval forces in the 2030 timeframe.
- (C) Traditional roles and missions of United States naval forces.
- (D) Alternative roles and missions for United States naval forces.
- (E) Other government and non-government analyses that would contribute to the study through variations in study assumptions or potential scenarios.
- (F) The role of evolving technology on future naval forces, including unmanned systems.
- (G) Opportunities for reduced operation and sustainment costs.
- (H) Current and projected capabilities of other United States armed forces that could affect force structure capability and capacity requirements of United States naval forces.

(d) **STUDY RESULTS.** The results of each study under this section shall

- (1) present the alternative fleet platform architectures considered, with assumptions and possible scenarios identified for each;
- (2) provide for presentation of minority views of study participants; and (3) for the recommended architecture, provide
 - (A) the numbers, kinds, and sizes of vessels, the numbers and types of associated manned and unmanned vehicles, and the basic capabilities of each of those platforms;
 - (B) other information needed to understand that architecture in basic form and the supporting analysis;
 - (C) deviations from the current Annual Long-Range Plan for Construction of Naval Vessels required under section 231 of title 10, United States Code;
 - (D) options to address ship classes that begin decommissioning prior to 2035; and
 - (E) implications for naval aviation, including the future carrier air wing and land-based aviation platforms.

LIST OF ACRONYMS

AAW	anti-air warfare
ACE	Air Combat Element
AEA	airborne electronic attack
AEW	airborne early warning
ALMDS	Airborne Laser Mine Detection System
AMD	air and missile defense
AMNS	Airborne Mine Neutralization System
AOR	area of responsibility
APS	active protection system
ARC	Adaptive Radar Countermeasures
ARG	Amphibious Ready Group
AS	submarine tender
ASBM	anti-ship ballistic missile
ASCM	anti-ship cruise missile
ASROC	ASW rocket
ASUW	anti-surface warfare
ASW	anti-submarine warfare
ATACMS	Army Tactical Missile System
BLADE	Behavioral Learning for Adaptive Electronic Warfare
BMD	ballistic missile defense
C2	command and control
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CAP	combat air patrol
CAS	close air support
CCDR	Combatant Commander
CDCM	coastal defense cruise missile
CENTCOM	Central Command
CESARS	Combined EO/IR Surveillance and Response System
CG	cruiser
CLF	Combat Logistics Force
CONSOL	consolidated refueling
CONUS	continental United States
C-RAM	compact rolling airframe missile

LIST OF ACRONYMS

CRS	Congressional Research Service
CS21	A Cooperative Strategy for 21st Century Seapower
CSG	carrier strike group
CUSV	Common Unmanned Surface Vehicle
CVL	light aircraft carrier
CVLWT	Common Very Light Weight Torpedo
CVN	nuclear aircraft carrier
CVW	carrier air wing
DARPA	Defense Advanced Research Projects Agency
DCA	defensive counterair
DDG	guided missile destroyer
DoD	Department of Defense
DPIA	Dry Docking Planned Incremental Availability
DSO	Distributed STOVL Operations
EAB	expeditionary advance base
EDSRA	extended dry-docking selected restricted availability
ELINT	electronic intelligence
EMALS	Electromagnetic Aircraft Launch System
EMS	electromagnetic spectrum
EO/IR	electro-optical/infrared
EPF	Expeditionary Fast Transport
ESB	Expeditionary Sea Base
ESSM	Evolved Sea Sparrow Missile
EW	electronic warfare
FAC	fast attack craft
FARP	forward arming and refueling point
FDNF	Forward Deployed Naval Forces
FF	frigate
FFG	guided missile frigate
FRTTP	Fleet Response Training Plan
FSA	Force Structure Assessment
GFMAP	Global Force Management Allocation Plan
HALE	high-altitude long endurance
HIMARS	High Mobility Artillery Rocket System

LIST OF ACRONYMS

HPRF	high-power radiofrequency
HVP	Hypervelocity Projectile
IFPC	Indirect Fires Protection Capability
Inc 2-I	Increment 2-Intercept
ISR	Intelligence, Surveillance, and Reconnaissance
IUSS	Integrated Undersea Surveillance System
JASSM	Joint Air-to-Surface Standoff Missile
JDAM	Joint Direct Attack Munition
JSOW	Joint Standoff Weapon
LCAC	Landing Craft Air Cushioned
LCS	Littoral Combat Ship
LCU	Landing Craft Utility
LDUUV	Large Displacement UUV
LDUUV INP	LDUUV Innovative Naval Prototype
LF	low frequency
LFA	low frequency active
LHA	Landing Helicopter Assault
LHD	Landing Helicopter Dock
LOCE	Littoral Operations in Contested Environment
LPD	amphibious transport dock
LPI/LPD	low probability of intercept /low probability of detection
LRASM	Long-Range Anti-Ship Missile
LSD	dock landing ship
LX(R)	next-generation dock landing ship
MALD	Miniature Air Launched Decoy
MALE	medium-altitude long endurance
MCM	mine countermeasures
MDUUV	Medium Displacement UUV
MIW	mine warfare
MOC	Marine Corps Operating Concept
MP	mission package
MPA	maritime patrol aircraft
MSC	Military Sealift Command
NATO	North Atlantic Treaty Organization

LIST OF ACRONYMS

NEMESIS	Multi-Element Signatures Against Integrated Sensor
NEO	Noncombatant Evacuation Operations
O&M	operations and maintenance
OFRP	Optimized Fleet Response Plan
ONR	Office of Naval Research
OPCON	operational control
OPTEMPO	operational tempo
PACOM	Pacific Command
PB17	President's Budget 2017
PIA	Planned Incremental Availability
Pk	probability of kill
PLA	People's Liberation Army
PLAN	People's Liberation Army Navy
RAS	replenishment at sea
RCOH	refueling and complex overhaul
RF	radiofrequency
RHIB	Rigid Hull Inflatable Boat
RPG	rocket-propelled grenade
SAG	Surface Action Group
SAR	synthetic aperture radar
SARs	Selected Acquisition Reports
SDB	Small Diameter Bomb
SDUUV	Small Displacement UUV
SEWIP	Surface Electronic Warfare Improvement Program
SIGINT	signals intelligence
SOF	special operations forces
SOSUS	Sound Surveillance System
SSBN	ballistic missile submarine
SSC	small surface combatant
SSGN	guided missile submarine
SSN	attack submarine
STOVL	Short Takeoff and Vertical Landing
SUW	surface warfare
T-AGOS	ocean surveillance ship

LIST OF ACRONYMS

T-AK	geared container ship
T-AKE	dry cargo/ammunition ship
T-AO	fleet replenishment oiler
T-AOE	fast combat support ship
T-AOT	CONSOL tanker
T-ATS(X)	combined salvage ship fleet tug
TERN	Tactical Exploitable Reconnaissance Node
TRAPS	Transportable Reliable Acoustic Path System
TTP	tactics, techniques, and procedures
UAV	unmanned aerial vehicle
UCAV	Unmanned Combat Aerial Vehicle
UDP	Unit Deployment Program
UHF	ultrahigh frequency
UISS	Unmanned Influence Sweep System
UNCLOS	United Nations Convention on the Law of the Sea
USV	unmanned surface vehicle
UUV	unmanned underwater vehicle
V(F)A	strike fighter squadron
V(U)A	unmanned strike squadron
VAMOSOC	Visibility and Management of Operating and Support Costs
VAQ	electronic attack squadron
VAW	airborne early warning squadron
VDS	variable depth sonar
VF	fighter squadron
VLS	vertical launch system
VPM	Virginia Payload Module
VRC	fleet logistics support squadron
XLUSV	Extra-Large Unmanned Surface Vehicle
XLUUV	Extra-Large Unmanned Underwater Vehicle



CSBA

Center for Strategic and Budgetary Assessments

1667 K Street, NW, Suite 900

Washington, DC 20006

Tel. 202-331-7990 • Fax 202-331-8019

www.csbaonline.org